THE ALBERTA JOURNAL OF EDUCATIONAL RESEARCH

VOLUME XXIII NUMBER 1 MARCH 1977

PUBLISHED BY
THE UNIVERSITY OF ALBERTA • EDMONTON

THE ALBERTA JOURNAL OF EDUCATIONAL RESEARCH

A quarterly journal devoted to the dissemination, criticism, interpretation and encouragement of all forms of systematic enquiry into education and fields related to or associated with education.

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Published quarterly in March, June, September and December
by the
Faculty of Education
of
The University of Alberta

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AJER gratefully acknowledges support from Canada Council and AACES.

AJER is indexed in the *Canadian Education Index;* appropriate articles are abstracted in *Educational Administration Abstracts, Psychological Abstracts,* and *Sociology of Education Abstracts.*

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Address all communications to the Editor, *The Alberta Journal of Educational Research,* Faculty of Education, The University of Alberta, Edmonton, Alberta, Canada T6G 2G5.

SECOND CLASS MAIL REGISTRATION NUMBER 1436

ISSN 0002-4805

The Alberta Journal of Educational Research

Volume XXIII, No. 1 *March, 1977*

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JOANNA TYLER
and
R. C. HARDY
University of Maryland

Effects of Age and Sex on the Acquisition of Form Discrimination

Forty subjects aged three (10 males and 10 females) and four (10 males and 10 females) were presented with a rotated, letter-like form discrimination matching task. The purpose was to investigate developmental changes across age and sex in acquisition of form discrimination. Results indicated that: (1) horizontal-vertical rotations were discriminated better than oblique rotations; (2) four-year-old females performed better than fou-year-old males on discriminating oblique rotations; and (3) four-year-olds performed better than three-year-olds on both kinds of rotations. Results suggested that age, sex, and type of rotation are important when training for form discrimination ability. (Ms. Tyler and Mr. Hardy are with the Institute for Child Study at the University of Maryland.)

The age at which children acquire the ability to distinguish variants of one visual pattern from variants of another has been of interest to investigators concerned with the process of how children learn to read. Gibson (1965) postulated that there are three phases in learning to read: (1) differentiating graphic symbols, (2) decoding letters to sounds, and (3) using progressively higher-order units of structure. This study focuses on the first phase of this process.

Two theories, maturational and learning, have been used to define the process by which a child acquires the ability to discriminate form. Two interactionists, Piaget and Inhelder (1956), suggested support for a maturational explanation of this phenomenon. Gibson (1965) provided support for a learning point of view. Gibson postulated a distinctive features hypothesis suggesting that form discrimination is a result of learning to detect the invariants of form. While this hypothesis has received some

support, attempts to use letter-like forms to train children's form discrimination ability in order that it might be transferred to new forms has only been successful with five-year-old subjects (Silver & Rollins, 1973). Silver and Rollins also noted that five-year-old males perform better than five-year-old females. It appears that learning to recognize the distinctive features of form is, perhaps, associated with readiness level of the child and may be linked to a sex variable. Consistent with this, Williams (1969) investigated the effectiveness of different training methods on acquisition of distinctive features and found that successful readiness training depends on the cognitive level of the child and the kinds of rotational transformation material presented. Kindergarten children made more discrimination errors on left-right orientations of letter-like forms than they did on up-down orientations of these forms, although discrimination training was more successful on the whole than reproduction training. Children with more kindergarten experience were more successful in discrimination training tasks than beginning kindergarten children. From these studies, it appears that the important variables are maturational level, sex, and type of transformation.

Despite this general conclusion in the literature, there is considerable research designed to teach children form discrimination techniques regardless of their readiness level. The work of Gibson, Gibson, Pick and Osser (1962) represents one of the few attempts to investigate the developmental aspects of form discrimination learning across age (four to eight) and sex. Results indicated that form discrimination ability increases from ages four to eight and that females aged four and five outperform males of similar age. Other research supports the notion that children's ability to discriminate and recognize different symbols or pattern of line figures begins to develop at age four and continues to improve until approximately age eight (Davidson, 1934, 1935; Welch, 1939; Ghent, 1961; Gibson et al., 1962; Rudel & Teuber, 1963; Bishop, 1964; and Rosenberg & Birch, 1969).

The differing performance among sex and age groups on various form discrimination tasks may have been a function of methodological variation. The kinds of form stimuli used to investigate this phenomenon appear to effect children's ability to discriminate the stimuli form. Jeffrey (1958) used left-right orientations of stick figures with four-year-old children to investigate the kind and amount of experience necessary in learning discrimination tasks. He found that four-year-old males and females could discriminate left-right orientations with ease. Jeffrey concluded that the critical time to stimulate form discrimination learning is at age four. While Williams (1969) found that 4½- to 5½-year-old children discriminate up-down orientations more easily than left-right orientations, she neither extended her investigation to include oblique orientations nor did she note sex differences.

Rudel and Teuber (1963) found that children aged three, four, and five failed to discriminate oblique orientations of a line. Both three- and four-year-olds could discriminate on the vertical and horizontal orientation; three-year-olds made more errors than four-year-olds. This ability to discriminate may have been due to the simplicity of the stimuli (one vertical or one horizontal line matched or mismatched with another line). Rudel and

Teuber's conclusion suggested that horizontal and vertical orientations are learned before the oblique orientation. More recent studies lend some support to this conclusion (Kolers & Perkins, 1969a, 1969b; Olson, 1970).

The previously cited research of Rudel and Teuber indicates that little difference exists between three- and four-year-old children on simple line discriminations. When the discriminations were horizontal and vertical, both ages could perform successfully but not significantly different from each other. When oblique orientations were used, neither group could perform discriminations successfully.

Jeffrey's research (1958) also supports this since he found that four-year-olds could discriminate left-right orientations of stick figures. It might be argued that certain forms, such as letter-like forms, are more easily assimilated by four-year-olds, due to their early contact with similar forms in preschool education, than three-year-olds who have not had as much contact with these forms. In addition, use of letter-like forms should make it easier for four-year-old children to discriminate the more difficult oblique orientations than when irregular patterns of lines are used as in the Rudel and Teuber study.

The purpose of the present investigation is to look at developmental changes in fine form discrimination ability between males and females aged three and four when letter-like forms are presented in horizontal-vertical and oblique rotations. It was predicted that children performed better when letter-like stimuli were rotated in the horizontal-vertical position rather than in the oblique position; that four-year-old females performed better than four-year-old males; and that four-year-olds (male and female) performed better than three-year-olds (male and female) on total, horizontal-vertical, and oblique letter-like form discriminations. From the above discussion, three null hypotheses are postulated:

1. For all children, there is no difference in performance on stimuli in the horizontal-vertical rotation than on stimuli in the oblique rotation.
2. There is no difference in the performance of four-year-old females from four-year-old males on total correct discriminations, horizontal-vertical discriminations, and oblique discriminations.
3. There is no difference in the performance of four-year-old males and females from three-year-old males and females in their ability to make correct discriminations on total correct discriminations, horizontal-vertical discriminations, and oblique discriminations.

Method

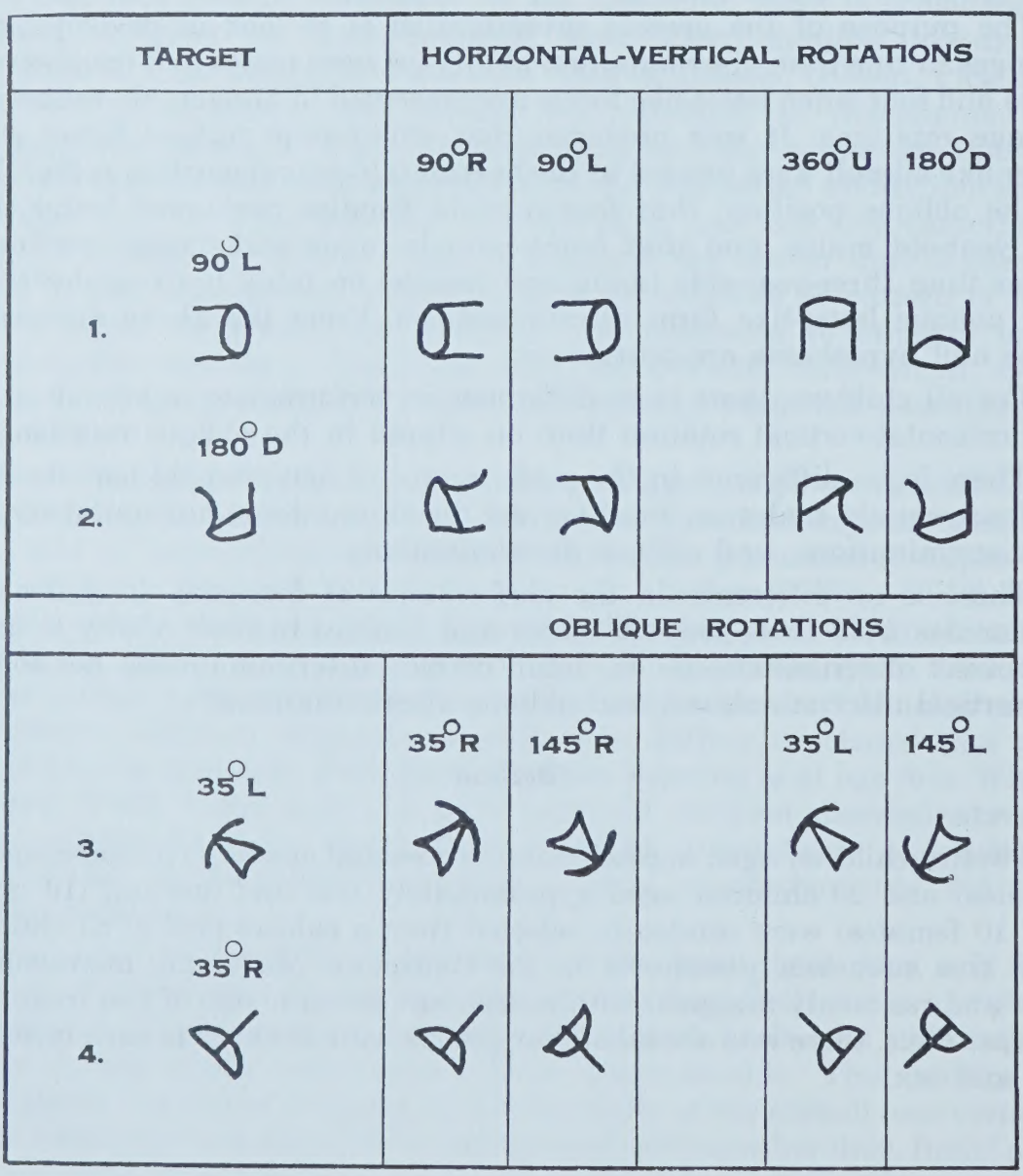
Subjects

Twenty children aged approximately three and one-half (10 males and 10 females) and 20 children aged approximately four and one-half (10 males and 10 females) were randomly selected from a subject pool of 83 children from five suburban preschools in the Baltimore, Maryland, metropolitan area and randomly assigned within each age group to one of two treatment groups. Thus, there was a total of four groups with 10 subjects each based on age and sex.

Materials

There was one set of 32 stimuli cards. Each card was a 20- by 6-inch (50.80 cm × 15.24 cm) masonite board bearing five 4- by 4½-inch (10.16 cm × 11.43 cm) black and white, high gloss photographed letter-like forms. (The letter-like forms on each card were selected from forms generated by Gibson et al., 1962.) Sixteen of the 32 stimuli cards represented horizontal and vertical rotations while the remaining 16 represented oblique rotations. Of the 16 horizontal-vertical rotations of letter-like forms, 8 represented horizontal rotations and 8 represented vertical rotations. In the horizontal rotation, the target figures were rotated 90° to the right and 90° to the left while in the vertical rotation, the letter-like forms were rotated 180° or not at all. Of the 16 oblique rotations, 8 letter-like forms represented rotations of 35° (four forms were rotated to the left and four to the right) and 8 represented rotations of 145° (four forms were rotated to the left and four to the right). Examples of these stimuli rotations can be found in Figure 1.

FIGURE 1
AN EXAMPLE OF THE HORIZONTAL-VERTICAL AND OBLIQUE ROTATIONS



It was the subject's task to match the target figure, which was rotated in the different positions described above, to one of four identical letter-like forms representing different rotations, one of which matched the rotation of the target figure. Thus five different positions were needed on each card. Position 1 was located to the left of the subject. It always displayed the target figure which was to be matched with one of the other four letter-like forms displayed in positions 2 through 5. This placement encouraged subjects to search the stimuli from left to right, the direction appropriate for reading English. Letter-like stimuli in positions 2 through 5 were randomized to prevent subjects from developing strategies about the position of the correct match.

Procedure

Each subject received one training trial. The following instructions were given:

> You sit here and I'll sit next to you and show you how to play a game. Look at all of these pictures (point). Now look at this picture (point). Next, look at these pictures and choose one of them that looks just like this one (point). You put your finger on the picture that looks just like this one.

If the subject responded correctly on the demonstration trial, the experimenter proceeded to give the 32 stimuli cards of one trial each, saying each time, "Which picture looks just like this one?" If the subject did not respond correctly to the demonstration trial, the instructions were repeated. If the subject failed to understand the instructions on the second reading, he was dropped from the pool of subjects and another subject was randomly chosen from the pool. Six of the originally selected 40 subjects were dropped.

The 32 stimuli cards were randomly split into four groups of eight stimuli cards. Each group contained one instance of each of the various rotations (90° left and right, 35° left and right, 145° left and right, 180°, and no rotation). The order of presentation of cards within a group was also randomly assigned. Each subject did all four groups, but the order of presentation was randomly assigned to him. All possible permutations (24) were utilized before any permutation was duplicated. This procedure was done in an effort to prevent a facilitating effect of starting position.

Data Analysis

To determine if any effect existed due to starting position, a 2×4 factorial design with two levels of stimuli rotation (horizontal-vertical and oblique) and four levels of starting position was used. The dependent variables were the number of correct responses on the horizontal-vertical and the number of correct responses on the oblique rotations. The level of significance for rejection of the null hypotheses was $p < .05$.

To test hypothesis 1 and the assumption that starting block position had no effect on performance, a 2×4 factorial analysis of variance was run between rotation (horizontal-vertical vs. oblique) and four levels of starting block position. To test hypotheses 2 and 3, a 2×2 factorial design with two levels of age (three-year-old and four-year-old) and two levels of sex was used. The dependent variables were the number of correct responses made on the horizontal-vertical rotation, the number of correct responses made on

the oblique rotation, and the total number of correct responses made on all 32 trials.

Results

Hypothesis 1

The means and standard deviations for starting block positions and rotations are shown in Table 1. The higher the score the better was the performance on the task. It can be seen from this table that the means for the horizontal-vertical rotations were higher than for the oblique rotations which was in the direction predicted.

TABLE 1
MEANS AND STANDARD DEVIATIONS ON STARTING BLOCK POSITION AND ROTATION

	Block Position			
	1	2	3	4
Oblique Rotation	7.00	6.47	6.25	5.92
	(2.36)	(3.52)	(3.09)	(2.43)
Horizontal-Vertical Rotation	10.33	13.53	10.75	9.23
	(2.66)	(3.64)	(2.63)	(4.19)

Note. Standard deviations are in parentheses.

Table 2 presents a summary of the 2 × 4 factorial analysis of variance. The results indicate that starting block position had no effect on performance, F (1, 72) = .49, $p > .05$. Thus, the assumption that starting block position does not effect performance was supported by the data. Horizontal-vertical rotations were discriminated significantly better than oblique orientations, F (1, 72) = 25.17, $p < .001$. Thus the first null hypothesis that there is no difference for all children in performance between horizontal-vertical rotations and oblique rotations was rejected.

Hypotheses 2 and 3

Hypotheses 2 and 3 were tested by performing three 2 × 2 factorial analyses of variance. The means and standard deviations for age and sex on the total trials, the 16 horizontal-vertical trials, and the 16 oblique trials are shown in Table 3. The means show that male and female four-year-olds performed equally well on the horizontal-vertical trials, but females had a higher mean performance than males on both total trials and oblique trials. Three-year-old males and females performed about equally well on all the dependent measures. Male and female four-year-olds performed better than male and female three-year-olds on all the dependent measures. Summaries of the analyses of variance can be found in Table 4.

Results of the analyses of variance for main effect of sex indicate that females performed significantly better than males on the oblique dimension,

TABLE 2
FACTORIAL ANALYSIS OF VARIANCE BETWEEN ROTATION AND STARTING BLOCK POSITION

Source	*SS*	*df*	*MS*	*F*
Rotation	281.25	1	281.25	25.17*
Block Position	16.44	3	5.48	.49
Rotation x Block	3.73	3	1.24	.11
Within	804.54	72		
Total	1105.95	79		

* $p < .001$

TABLE 3
MEANS AND STANDARD DEVIATIONS FOR AGE AND SEX ON EACH CRITERION

	Age 4		Age 3	
	Male	Female	Male	Female
Horizontal-Vertical Rotation	11.21	11.70	8.81	8.70
	(3.42)	(3.33)	(3.01)	(3.83)
Oblique	5.60	8.90	4.90	6.00
	(1.89)	(2.84)	(2.33)	(3.05)
Total	16.90	20.60	13.70	14.70
	(4.77)	(5.21)	(4.66)	(6.39)

Note. Standard deviations are in parentheses.

F (1, 36) = 7.31, $p < .01$. There were no significant results for the horizontal-vertical, F (1, 36) = .03, $p < .05$, or total responses, F (1, 36) = 1.96, $p > .05$. A Neuman-Keuls procedure performed on the oblique measure indicated that four-year-old females did better than four-year-old males, three-year-old males, and three-year-old females at $p < .05$ level of significance. Since there were no main effects for sex on the horizontal-vertical or total response measures, a Neuman-Keuls procedure was not performed on these data. Therefore, results of this study only partially supported the predicted position. The second null hypothesis that there was no difference in the performance of four-year-old females from four-year-old males on total correct discriminations, horizontal-vertical discriminations, and oblique discriminations was rejected for only the oblique measure.

Results of the analyses of variance for the main effect of age indicated that four-year-old children performed significantly better than three-year-old children on total responses, F (1, 36) = 7.35, $p < .01$, horizontal-vertical responses, F (1, 36) = 6.26, $p < .01$, and oblique responses, F (1, 36) = 4.90,

TABLE 4
FACTORIAL ANALYSES OF VARIANCE FOR TOTAL CORRECT RESPONSES

Source	SS	df	MS	F
(a) Total Correct Responses				
Age	207.03	1	207.03	7.35**
Sex	55.23	1	55.23	1.96
Age x Sex	18.23	1	18.23	.64
Within	1013.50	36	28.15	
Total	1293.98	39		
(b) Horizontal-Vertical Responses				
Age	72.90	1	72.90	6.26**
Sex	.40	1	.40	.03
Age x Sex	.90	1	.90	.07
Within	419.40	36	11.65	
Total	493.60	39		
(c) Oblique Responses				
Age	32.40	1	32.40	4.90*
Sex	48.40	1	48.40	7.31**
Age x Sex	12.10	1	12.10	1.82
Within	238.20	36	6.61	
Total	331.10	39		

* $p < .05$
** $p < .01$

$p < .05$. These results supported the predicted position. Therefore, the third null hypothesis that no difference in performance exists for four-year-old males and females from three-year-old males and females in their ability to make correct discriminations on total trials, horizontal-vertical trials, and oblique trials was rejected.

Discussion

Since all children perform better on stimuli in the horizontal-vertical rotation than on stimuli in the oblique rotation, the first null hypothesis is rejected. This, therefore, supports the previously mentioned positions of Rudel and Teuber (1963) and Jeffrey (1958). Furthermore, since there was no difference in starting block position, randomization of starting positions served as an adequate control in measuring the effect of rotation.

Although four-year-old females perform better on oblique rotations than do four-year-old males, they did not perform better on horizontal-vertical or total rotations. Consequently, the second null hypothesis which states that no difference in performance between four-year-old females and males would exist on total, horizontal-vertical, and oblique rotations was rejected for only

oblique rotations. In addition, a significant mean comparison indicates that four-year-old females perform better than three-year-old females on the oblique rotation. Three-year-old males and females perform similarly on the oblique orientation. While it appears that oblique form discrimination tends to crystalize in females during their fourth year, this does not appear to be true for males.

There are no differences between four-year-old males and females in discriminating letter-like forms in horizontal-vertical rotations. Although Rudel and Teuber (1963) and Olson (1970) reported that the oblique rotations are more difficult than horizontal-vertical rotations for young children to discriminate, results of this study suggest that this relationship is true for all young males but not for four-year-old females.

An explanation for the differential ability between males and females to discriminate form is possibly a function of different neurological development. Dick (1976) mentioned that Held supports the notion that there are two visual systems, one specialized for form perception and another specialized for space perception. Males and females have been shown to differ in their ability to use these two visual systems. For instance, females are more adept at two-dimensional kinds of perception, while males tend to perform better on spatial orientations where use of a three-dimensional system is most effective. If males and females initially respond in neurologically different ways, then four-year-old females' ability to excel four-year-old males in discriminating the rather difficult oblique angle appears to demonstrate support for a maturational theory of form discrimination ability. This, coupled with the notion that four-year-olds have more experience with form than three-year-olds, may suggest that females benefit more than males from their initial letter experiences as a result of their differential neurological development.

Since four-year-old children perform better than three-year-old children on all form discrimination criteria, the third null hypothesis that no difference exists in performance of four-year-old males and females from three-year-old males and females in their ability to make correct discriminations on total trials, horizontal-vertical trials, and oblique trials was rejected. It is suggested that this difference might be due not only to maturational differences, but also to the early learning experiences of the child, particularly in the preschool setting. The four-year-old children in this study had one more year of school experience than did the three-year-old children. Perhaps the task of letter-like forms was more familiar to the four-year-old group than it was to the younger children. The significant difference between age groups may, however, only be a result of the high scores achieved by the female subjects in the four-year-old group.

The suggestion that females use their neurological structure for analyzing two-dimensional form at an earlier age than males tends to support a maturational theory for form discrimination ability. This, in conjunction with the learning position stated above, would seem to indicate that an interactionist position, as advocated by Piaget and Inhelder (1956), would be a more appropriate position in accounting for the results of the data in this study.

It appears that children go through a sequence of form discrimination

stages. Total mean scores for the horizontal-vertical rotations were greater for both age groups than were the oblique rotation scores. This suggests that children's ability to discriminate horizontal-vertical rotations develops before the ability to discriminate oblique rotations.

It should be noted that the results of this study can be generalized only to the schools used in this study. Further research would be useful to confirm these results in a larger population. If these results are consistent with future findings, early childhood education curricula designed to teach prereading skills by using form discrimination tasks should be re-evaluated. Given that males and females may initially respond to form in neurologically different ways, it might be beneficial to teach boys prereading skills or discrimination tasks by using three-dimensional letters rather than by using the standard two-dimensional system of letters. In addition, evidence presented in this investigation tends to support an interaction theory of early childhood learning. If this theory is correct, children can most readily acquire new learning when teacher knowledge of their developmental, cognitive stage, and sex is coupled with information as to how appropriate readiness training material can best be presented.

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The Alberta Journal of Educational Research *Vol. XXIII, No. 1, March, 1977*

H. L. JANZEN
The University of Alberta
and
H. J. HALLWORTH
The University of Calgary

Linguistic Predictors of Properties of Set

The present study was an attempt to clarify the relational and predictable aspects of language behavior to Uznadze's (1966) concept of objectification. One hundred and eighty-six subjects were given the Uznadze set tasks and were asked to write an essay of a biographical nature. Essays were keypunched and scored by computer using Page's (1966) SCORETEXT program. Stepwise multiple-regression analysis identified that linguistic codes which embody content that is analytical and abstract are indicative of individuals who excite quickly in the Uznadze set tasks. Specifically, for those individuals who excite in the visual mode rather than in the haptic mode, the conscious act of cognitive activity suggests greater complexity, more abstraction and greater qualification in linguistic expression. The study suggests that developing greater facility in linguistic skills may well produce greater cognitive differentiation and enhance the process of objectification. (Dr. Janzen is Associate Professor in the Department of Educational Psychology, The University of Alberta; Dr. Hallworth is Professor of Educational Psychology and Director of the Computer Assisted Instructional Unit, The University of Calgary.)

For western psychologists, the concept of set has been explained and analyzed on several dimensions. For example, Woodworth (1937) considered a *motive* to be similar to set. Dashiell (1949) refers to set as attending to particular stimuli which facilitate a response. Allport (1955) extended this behavioral definition to perception and to practically all types of behavior. According to Allport, set determines the course of learning as part of the learning process, a mechanism of drive or habit. Helson's (1964) adaptation level has been referred to as set. For him, set is a response (sometimes subjective, sometimes unconscious), an adaptation of the individual to incoming stimuli.

Uznadze (1958) conceived set, not as a mental or biological response nor, as in adaptation-level theory, a reference point for incoming stimuli; set, for Uznadze, was not a peripheral sensation, but a central, orienting, and integrating mechanism controlling all behaviour. Uznadze saw set not as a group phenomenon, but as an individual characteristic, emerging out of a need, and giving direction and purpose to every human act. Sets evolve out of a dynamic interaction of the person, his needs, and his environment. Set is a "unitary," "integrating," "orienting" mechanism, rather than a motor or mental phenomenon.

In Uznadze's theory, the primary means of halting or immobilizing set is through the process of objectification (or objectivization, as in Uznadze, 1966). As an explanatory concept, this process called "objectification" is perhaps the most central issue in Uznadze's theory. It is at the level of objectification that theoretical cognitive needs emerge. The process of objectification brings into consciousness the situation at hand. It approximates the individual's subjective representation to objective reality. As Uznadze (1961) says, "Every separate act of thought arises out of this process" (p. 161). Since thinking is usually done in a language, language becomes the means whereby man can halt a set through the process of linguistically objectifying the problem-situation, and then call in another set to action. In this way, set, language, and the process of objectification are inextricably tied. In addition, both set and language reflect (1) a person's needs and (2) the influence of the environment surrounding the individual (Bernstein, 1962a, 1966; Uznadze, 1966). The process of objectification, then, utilizing language as its means of cognitive expression, should be different for each individual, depending on the interaction of the two factors mentioned above.

It is precisely this relationship that Hertzog (1968) investigated. He postulated that the "signals" or situations to which an individual can respond will be a function of the environment found in that person's social structure. It is these signals that the individual will objectify in a cognitive relation (the process of objectification) and hence form the basis for the development of his thought and language. On this basis, the process of objectification will be different for each person, resulting in different approximations of reality and reflected in the language usage. This same concept is quite clearly related to Nunnally and Flaugher's (1963) idea of the psychological implications of individual differences in word usage. Hertzog felt that the more dynamic the psychological state of readiness for activity, the more effective will be the interaction of the individual with his environment and the more adequately will information be processed by the individual (Hertzog, 1968).

According to set theory, Hertzog predicted that individuals who excited and extinguished quickly either in the haptic or visual modality would exhibit elements of Bernstein's (1966) elaborated code. Those who excited and extinguished slowly would exhibit elements of Bernstein's restricted code. In general, this basic hypothesis was confirmed. Significant predictors of rapid excitation and extinction in the haptic and visual modalities were: (1) Adjectives, (2) Personal pronouns, (3) Abstraction words, (4) Uncommon adverbs, (5) Essay length, and (6) Verbs. High rate excitation groups, haptically or visually, distinguished themselves in the greater use of

adjectives. High rate of extinction in haptic modality groups preferred greater use of adverbs. The fast extinction group in the visual modality used greater elements of subordination. Uznadze's set theory and Bernstein's codes seemed to have some sense of theoretical verification. Reality, objectified through sets, did bear resemblance through linguistic expression, based upon cognitive differentiation. Written language did seem to reflect either a greater or lesser degree of objectification within each individual (Hertzog, 1968).

In attempting to elaborate and verify Hertzog's findings, as well as to clarify the linguistic aspects of the Soviet concept of "objectivization," the present authors felt it necessary to analyze a greater number of written essays. Hertzog analyzed eighty documents only. As can be expected, the data that must be examined in language research is so overwhelming both in quantity and complexity, that computers come as a relieving aid. In order to do this, however, certain basic assumptions have to be made. The following is a rationale for using content analysis procedures and an empirical analysis of the language categories chosen in the present study.

The technique used to analyze written documents, first developed by Stone, Dunphy, Smith and Ogilvie (1966), was content analysis. Stone argued that through the analysis of raw data, the behavioral scientist can often learn much about the personalities and preoccupations of writers. A basic assumption made in this study is that words and symbols used in written communication are indicative of many latent attributes of the source of that communication. Considerable research has established the empirical evidence that frequency counts on certain linguistic categories provide consistent relationships for personality and cognitive attributes of individuals (Newbigging, 1961; Nunnally & Flaugher, 1963; Gottschalk & Hambidge, 1955). It is only reasonable to suggest, however, that computer analysis can only rely on syntactic and lexical cues and, therefore, many denotative and connotative meanings in writing are often missed.

Method

Linguistic Measures

The linguistic measures developed or borrowed for this research are shown in Table 1.

The first six categories were established by computer analysis of a total of 400 essays. A print-out of all different words (type-tokens) and their frequency were given. These words were then classified and compared with the Thorndike-Lorge (1944) word frequency list. Only those words having a frequency count of 20,000 or more were included in the language dictionaries of verbs, adjectives and adverbs. In this way, actual sample data was used to define the language category, and a more accurate and consistent word-count by computer was assured. Measures 4, 5, and 6 included all relevant words fitting into that category. The variable "Length of Essay in Words" was simply a wordcount. The remaining categories are reported in Table 1 and were used because empirical evidence existed for their validity and reliability. Measures 8, 9, and 10, for example, had reported reliability coefficients (KR-20) of .79 to .83 (Nunnally & Flaugher, 1963).

TABLE 1
LINGUISTIC CATEGORIES DEVELOPED EMPIRICALLY

Linguistic Measures	Research Source
1. Number of Verbs (passive and active)	Measures 1 to 7 were developed empirically at the University of Calgary and published by Janzen (1973).
2. Number of Adjectives	
3. Number of Adverbs	
4. Prepositions	
5. Subordinate Conjunctions	
6. Personal Pronouns	
7. Length of Essay in Words	
8. Positive Evaluators	Measures 8, 9, and 10 were taken from Nunnally and Flaugher (1963).
9. Negative Evaluators	
10. Denotation and Abstraction Words	
11. Opinionation Words	Measures 11, 12, and 13 were taken from Hiller, Marcotte and Martin (1969).
12. Vagueness Words	
13. Specificity Words	

Sample

One hundred and eighty-six subjects participated in the study. All subjects were first-year students at the University of Calgary.

Of the 186, one hundred and seventeen were females, sixty-nine were males. Since Hritzuk (1968) found no sex difference in the set variables, males and females were combined in the statistical analysis.

Procedure

The independent variables were the linguistic measures determined by a written response to a suggested topic. The topic was a general one allowing maximum personal expression and freedom. No time limit was imposed. Approximate average length of an essay was 750 words.

The essays were key-punched on IBM cards and analyzed by a 360/50 computer using Page's SCORETEXT program (Page, 1966, 1967). The categories, in the order they appeared in the analysis, formed the predictor measured and were as follows:

1. Number of positive evaluation words
2. Number of adjectives
3. Number of verbs
4. Number of adverbs
5. Number of personal pronouns
6. Number of subordinate conjunctions
7. Number of prepositions
8. Number of negative evaluation words
9. Number of abstraction words
10. Number of opinionation words
11. Number of vagueness words
12. Number of specificity words
13. Length of essay in words.

All measures were standardized by dividing the count by essay-length and multiplying by a constant.

The dependent variables were the characteristics of set. To test for set properties the following equipment was used:

(a) tachistoscope.
(b) two slides: one slide had two unequal circles, 30 mm. and 15 mm. in diameter; the other slide had two equal circles of 22.5 mm. in diameter.
(c) Three wooden spheres with handles. One sphere was 100 mm. in diameter, the other two spheres were 70 mm. in diameter; each sphere had a total weight of 300 grams.

The gathering of the set data involved individual testing. To test for a set in the haptic modality, the subject was seated with hands resting on the thighs and palms upward. He was blindfolded and the following instructions were then given:

> I am going to present two spheres to you, one to each hand. You may grasp them for a moment and then I shall remove them. I shall repeat this a number of times. Each time I do this, please tell me if the spheres feel equal or unequal in size. If you think that they are unequal in size, tell me in which hand you feel the larger one. Please be sure to tell me each time I do this.

Following this, the two spheres of unequal size were placed in the palms, with the larger sphere placed in the right palm (setting tests). The subject was allowed to grasp the spheres and then they were removed. Then the test for set was made. This was done by presenting the two equal spheres without informing the subject (critical test). If they appeared unequal, a set had been fixated. If no fixation appeared (i.e., they felt equal in size), then the setting trials were resumed. Critical trials followed after every setting trial until a set had been fixated, or to a maximum of 20 setting trials. The verbal response given after each trial was recorded.

When the subject perceived the two equal spheres as unequal, a set had been established. To extinguish, the critical trials (presentation of equal spheres) were continued until the spheres were perceived periodically for five consecutive trials or to a maximum of 20 critical trials. The response after each critical trial was recorded.

To test for set in the visual modality, the subject was asked to focus her eyes on the binocular part of the tachistoscope. The instructions were:

> You will be shown two circles briefly. Each time you see the circles I want you to tell me if the circles appear to be equal or unequal in size. If you think they are unequal, tell me which circle appears larger to you. Please be sure to tell me each time I flash circles on the screen.

The slides with the circles on them were presented for 0.1 second. The setting trials now followed the exact procedure as described above. The response after each trial was recorded.

When the subject perceived the equal circles as unequal, a set had been fixated. To extinguish, the critical trials (presentation of equal circles) were continued until the circles were perceived veridically for five consecutive trials, or to a maximum of 20 critical trials. The response after each trial was recorded.

To test for intermodal transfer, the subject was asked to look continuous-

ly into the tachistoscope and at the same time to place his hands on the table in front of him with the palms upward. The instructions were:

> I am going to place the spheres in your palms again, just as I did a few minutes ago when I blindfolded you. I am also going to flash the circles on the screen every so often. However, this time you do not have to tell me what the spheres feel like. I want you to keep your eyes on the screen and whenever you see the circles, tell me if they appear equal or unequal in size. If they appear unequal to you, tell me on which side the larger one appears. Please be sure to tell me each time I flash the circles.

One setting trial with the unequal spheres was then given with the larger sphere placed in the right hand. This was followed by the presentation of the equal circles for 0.1 seconds by means of the tachistoscope (critical test). If the two circles appeared unequal, then the set fixated in the haptic sphere had been transferred to the visual modality. If the spheres were seen as equal, the setting trials were continued in the haptic sphere and the critical tests in the visual modality subsequently after every setting trial until a set had been transferred or to a maximum of 20 trials. The responses were recorded.

The procedure described above is similar to that used by Uznadze (1958). The cut-off scores used in the set tests were derived from Hertzog (1968) and Hritzuk (1968).

Each subject was scored according to the number of trials required to fixate and extinguish a set in the haptic and visual modalities, and the number of trials before irradiation occurred. The following set categories were obtained:

A. Rate of excitation in the haptic modality
   (1) Fast (1-5 trials)
   (2) Slow (6-21 trials)
   (3) None (no excitation)

B. Rate of extinction in the haptic modality
   (4) Fast (same criterion as above)
   (5) Slow
   (6) None

C. Rate of excitation in the visual modality
   (7) Fast
   (8) Slow
   (9) None

D. Rate of excitation in the visual modality
   (10) Fast
   (11) Slow
   (12) None

E. Number of trials before irradiation took place from the haptic to the visual modality
   (13) Fast
   (14) Slow
   (15) None.

It is important to note that these measures were dichotomized to allow a discrete analysis of the speed of excitation, extinction, and irradiation, with significant linguistic variables. The categorization procedure was similar to that used by Hritzuk (1968).

Data Analysis

For the data analysis, a step-wise multiple-regression program operated by the University of Alberta Research Division was used. No prior entry and deletion levels were set for criterion and predictor variables. Means, standard deviations and Pearson *r* correlations were computed.

Results

In the regression analysis all linguistic measures were entered for each of the fifteen criterion set characteristics. The analysis produced five set measures that showed significant relationship to the language variables.

Table 2 reports the step-down P values for all statistically significant (.05 level) predictor measures for the criterion "Fast Excitation in the Haptic Modality". For the thirteen linguistic measures, all but five showed a significant predictive relationship to the criterion. The variables in this regression equation indicate that the significant predictors are not function words, but content words. The group of language measures produces no clear-cut picture of the process of objectification. Suffice it to say that those individuals who excite *quickly* in the haptic modality exhibit greater action in writing (verbs), tending to self-reference (pronouns) and abstraction, whether specific or not.

TABLE 2
STEP-WISE REGRESSION WITH ALL LINGUISTIC VARIABLES PREDICTING THE CRITERION "FAST EXCITATION IN THE HAPTIC MODALITY"

Linguistic Measures	Step-Down F	Step-Down P
Negative Evaluation Words	5.01	.026
Vagueness Words	3.10	.047
Pronouns	2.68	.048
Opinionation Words	2.86	.024
Adverbs	2.65	.024
Specificity Words	2.36	.032
Verbs	2.13	.041
Denotation-Abstraction Words	1.95	.054

All predictor variables were entered. Restriction levels for entry and deletion in the regression equation were not set.

The other set variables that showed significance in the analysis were: (1) Slow Excitation in the Haptic Modality and (2) No Excitation in the Haptic Modality.

For these two criterion measures, four language categories proved significant predictors. From Table 2 it is seen that no new variables were entered in this equation that did not appear for the previous one. For the criterion "Slow Excitation," however, the three language measures seem to indicate that those individuals who excite slowly, or not at all for that matter, write predominantly in a qualifying and vague way (verbs, adverbs, vagueness). These variables might indicate that, in Uznadze's terms, people who excite slowly or not at all do not respond in a dynamic manner (Unadze, 1966). Their cognitive style is static, less personal, and, in general, possesses a more limited approximation of reality (Hertzog, 1968).

TABLE 3
STEP-WISE REGRESSION WITH ALL LINGUISTIC VARIABLES PREDICTING EXCITATION IN THE HAPTIC MODALITY

Linguistic Measures	Step-Down F	Step-Down P
Slow Excitation		
Adverbs	6.54	.011
Verbs	3.74	.025
Vagueness Words	2.73	.044
No Excitation		
Opinionation Words	3.74	.054

TABLE 4
STEP-WISE REGRESSION WITH ALL LINGUISTIC VARIABLES PREDICTING THE CRITERION "SLOW EXCITATION IN THE VISUAL MODALITY"

Linguistic Measures	Step-Down F	Step-Down P
Adjectives	5.10	.024
Positive Evaluation Words	3.89	.022
Prepositions	3.71	.012
Subordinate Conjunctions	3.40	.010
Opinionation Words	2.94	.013
Pronouns	2.61	.018
Negative Evaluation Words	2.32	.026
Vagueness Words	2.09	.038
Adverbs	1.91	.052

Table 4 reports the only visual set category that had significant linguistic predictors.

Slow excitation in the visual modality has almost similar predictable attributes as excitation in the haptic mode. The differentiating variables, as evidenced in Table 4, are those of adjectives, prepositions, and subordinate conjunctions. This indicates that, as in the haptic mode, those who excite quickly in the visual mode have very diverse linguistic cognitive expression, but a greater tendency to complexity in writing. The complexity factor can be identified by the unique additional predictor variables. Evidence by Bernstein (1966), Lawton (1963, 1964), Page (1967), Percival (1966) and others indicates that those linguistic elements (preposition, subordinate conjunctions) are markers or proxies of elements considered "complexity in writing." Furthermore, the inclusion of these function words, by nature being resistant to change, might indicate constructive thinking, and objectification process tending toward contemplation.

The final significant set criterion was "Slow Irradiation from the Haptic to the Visual Modality." Results are reported in Table 5. Again, the usual eight language measures are entered. There is one unique element here, however, and that is the entry of the variable "length of essay in words." Uznadze (1966) states that the evidence of irradiation indicates the "transmodal nature of set," a single set expressing itself in different modalities. The variable "essay length" has been said to indicate a richness

TABLE 5
STEP-WISE REGRESSION WITH ALL LINGUISTIC VARIABLES PREDICTING THE CRITERION "SLOW IRRADIATION FROM THE HAPTIC TO THE VISUAL MODALITY"

Linguistic Measures	Step-Down F	Step-Down P
Negative Evaluation Words	5.02	.026
Specificity Words	4.00	.019
Pronoun	3.48	.016
Adverbs	3.07	.017
Prepositions	2.58	.027
Length of Essay	2.33	.034
Subordinate Conjunctions	2.14	.041
Denotation-Abstraction Words	1.96	.053

of production, a richness of the verbal planning and translation act, a sign of an individual possessing the "elaborated code" (Bernstein, 1962a, 1966; Page, 1967; Hertzog, 1968; Janzen, 1973). Apart from the other linguistic attributes in visual and haptic excitation, the fact that essay length appeared here supports Uznadze's contention that individuals who show irradiation express themselves in a complex and elaborate way. Perhaps this leads one to believe that such individuals possess a more complex conceptual hierarchy (Ausubel, 1965; Hertzog, 1968).

One further finding warrants mentioning. The fact that "Number of adverbs" was the only predictor common to excitation, haptically and visually, and to the irradiation measure indicates support of Hertzog's (1968) finding that this same variable demonstrates the existence of an elaborated code. Use of adverbs has also been found to demonstrate a discriminating and intensifying quality of writing (Lawton, 1964; Cliff, 1959).

Discussion and Conclusions

In the Uznadze theory of sets, the concept of objectification is referred to as an act that leads to the solution of a specific problem and a new set toward that problem. Since the activity of objectifying is linked to language (Uznadze, 1966; Hertzog, 1968), it was assumed that specific aspects of style or vocabulary usage in writing would elaborate on the relationship between activated attributes of sets and their linguistic correlates. Uznadze presents no empirical evidence relating the act of objectification to such specific language factors.

For Uznadze, this internal preconscious state known as *set* exists in the subject as an integral state. It is not, according to Uznadze, an isolated mental quality to be contrasted with other conscious qualities. It is the determining factor in the dynamics of the mind. The illusions are manifestations of the activity of the set. Because sets arise out of the individual's needs and his environment, one can safely assume that mediation is involved for the occurrence or altering of a set (Uznadze, 1966). Mediation through the process of objectification, implying language thereby, becomes one way of clarifying how individuals accommodate previous experiences, and how it is evidenced through one specific medium, namely writing.

The present study has shown that the excitation and irradiation of illusions in haptic and visual modalities have some unique linguistic attributes. Those individuals who excite quickly in the haptic modality have a tendency toward action (verbs being a unique predictor for this group of individuals). This may mean that those individuals have a process of objectification that is alert and active. Their reality is objectified through language that depicts excitement, activity, and perhaps emotional stability.

On the other hand, for those individuals who excite slowly in the visual sphere, the predominant linguistic attribute of objectification here is the use of adjectives. According to Katter (1964) and Lawton (1963, 1964), this would indicate a cognitive differentiation predisposed to analysis and evaluation. Also, since adjectives signify personal reactions to objects, it indicates a quality of feeling and emotional explicitness. The way these individuals would activate and change a set through the process of objectification would be quite different from that of individuals who excite quickly haptically. For the visual mode, the conscious act of cognitive activity suggests greater complexity, more abstraction, more qualification before new sets for new activity are aroused.

The unique linguistic attribute of irradiation has already been referred to. The variable "length of essay in words" was the defining characteristic. In Uznadze's research, many subjects would not irradiate a set from one modality to another modality. Since Uznadze found the presence of irradiation from preschoolers to adults, obviously various degrees of complexity or internalization of the word by an individual are possible. The fact that "length of essay" is the unique linguistic attribute of this phenomenon points to the availability within the subject of a greater range of linguistic symbols from which to draw. It could also imply that the more sensitive a person's nervous system is, the greater the degree of irradiation, the greater the internal store of linguistic signals.

Developing a wide capacity in linguistic skills may well serve to produce greater cognitive differentiation and enhance the process of objectification (Ausubel, 1965; Witkin, Goodenough & Karp, 1967). Furthermore, since sets toward an activity can be helpful in producing problem-solving behavior (Uznadze, 1966) and since language and thinking are intimately related (Carroll, 1964), perhaps the development of linguistic skills would further an individual's ability to process information. Through the medium of language instruction, therefore, the development of the process of objectification would be enhanced, allowing the student to stop, think, and re-experience reality.

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The Alberta Journal of Educational Research *Vol. XXIII, No. 1, March, 1977*

L. D. NELSON
and
T. E. KIEREN
The University of Alberta

Children's Behavior in Solving Spatial Problems

This is a report of the observed behavior of children in the age range three to eight years while solving a series of spatial problems. Elements of a cube, a regular tetrahedron, and a regular dodecahedron were constructed of Plexiglas and Velcro so that the elements could be easily assembled to their three-dimensional form and disassembled to a two-dimensional form. Children in this range displayed a variety of behaviors while attempting to form the three-dimensional shapes, but most of them were successful. There was a distinct reluctance on the part of about half the children at each age range to make predictions about the foldability of given two-dimensional layouts. Children are good builders but do not want to say in advance what form their structures will take. (Dr. Nelson is Professor in the Department of Elementary Education and Dr. Kieren is Professor in the Department of Secondary Education, The University of Alberta.)

Developing the ability to solve problems has always been a primary aim in mathematics instruction at any level. In today's complex and changing world, that objective is probably more important than it has ever been. Since problem-solving activities such as grouping, classifying, constructing, and exploring are characteristic of young children, it would appear that problem-solving can be an appropriate aim, as well as a useful vehicle, for learning mathematics in early childhood.

What, precisely, should be the problem-solving goals for young children? Clearly, the focus cannot be on the solution of story problems. These almost invariably, unless they are trivial, involve a considerable sophistication in the use of the symbols of mathematics which young children do not have.

The goal must be oriented to the solution of real problems which can be given a concrete existence for the children.

But how can such problems be constructed? Is there a catalogue of behaviors which characterize children's activities when they face such problems? Are the behaviors age-related? Does such problem-solving experience transfer to other situations and does it affect how the child thinks about new situations? Nelson and Sawada (1975) have attempted to find the answer to these and related questions in a series of cross-sectional and longitudinal studies.

This report represents an analysis of the cross-sectional data of one problem task included in these studies. Other studies in the series focus on problems of sequences, operations, coordinates, factors, and reflections in a plane. It is hoped that analysis of children's behavior in these situations will provide further insight into the highly complex human behavior called mathematical problem-solving and will offer suggestions for the construction of problem-solving curriculum items for young children.

Related Research

Despite a long history of interest in problem-solving and the current emphasis given to it in mathematics instruction, problem-solving behaviors of young children—or any other age group for that matter—have not been carefully studied (Kilpatrick, 1969). There has, of course, been the remarkable work of Polya (1957) in which he tried to analyze problems and problem sequences in terms of the thinking processes which he conjectured were needed to solve them. Although based upon years of observation and insightful teaching, Polya's work suggests how the problem-solving process *should* proceed rather than how children actually proceed when working on a problem.

Piaget and Inhelder (1967) discussed at length the attempts of subjects aged five to sixteen to represent their concept of what shape various solids would assume "if we open it out flat on the table" (p. 274). While clearly related to the work reported here, the purpose and hence the focus of this Genevan research was on the representation of space. While the current study makes use of similar geometric objects, the child was engaged in predicting the constructibility of solids and in actually constructing them. Hence, the motor skills needed for representation were not required.

Genkins (1975) reports a study of subjects in kindergarten and grade 2 as they learned the concept of bilateral symmetry under two instructional conditions. She found that younger children were more successful using paper folding rather than mirror techniques and that they generally performed at a lower level than their grade 2 counterparts. While these results have some implications for the technical aspects of geometric problem-solving, her work relates only tangentially to the present investigation. The Genkins study focussed on learning a particular geometric concept, symmetry, while the study reported here is concerned with the free responses of children to geometric problems.

It was not the purpose of this study to generate a theory of problem-solving (although it did attempt to validate a concept of "good" problems advocated by Nelson and Kirkpatrick [1975]). It was not designed to test a

theory of space perception or conception, nor did it focus on geometric concept learning. It did attempt to provide data and analysis upon which to base future development of geometric problem-solving objectives for young children.

Method

To help answer the kinds of questions asked at the outset, it was necessary first to provide the child with some means of representing stable three-dimensional solids which could be readily disassembled into two-dimensional networks and as readily re-assembled to their three-dimensional form. For the purposes of this investigation, the regular solids chosen for representation were the cube, the tetrahedron, and the dodecahedron.

To fulfil the requirements of easy assembly and disassembly, the elements of the solids were cut from ⅛-inch Plexiglas. There were six square shapes for the cube, four equilateral triangular shapes for the tetrahedron and 12 regular pentagons for the dodecahedron. The sides of these shapes all measured 10 centimetres. Alternate faces of the material called Velcro were than glued to adjacent sides of each of these elements. Velcro comes in strips with two facing sides, one of which is a plushlike fabric and the other a material consisting of a mass of tiny hooks. When the two sides come in contact, the hooks engage themselves in the softer fabric to form a join of the two sides. The photograph shows the structure of some Plexiglas shapes with the attached Velcro. A series of tasks suitable for children was devised around this apparatus.

A sample of 60 children, 10 at each age from three to eight, was chosen from a list of 200 volunteer subjects, on the basis of the availability of the subjects during the vacation period. The apparatus was placed on a low table at which each child in turn was seated. An interviewer sat beside the child and presented the tasks associated with each problem according to a pre-arranged and pretested protocol. All behavior of the child as he worked through the tasks was recorded on ½-in. video tape. During the session, each child worked six different problems with six different problem apparatus. The construction of several three-dimensional shapes from the apparatus described and presented above represented one problem situation. The behavior of children as they constructed these shapes was analysed and is reported here. Reports on the other problems are now in preparation.

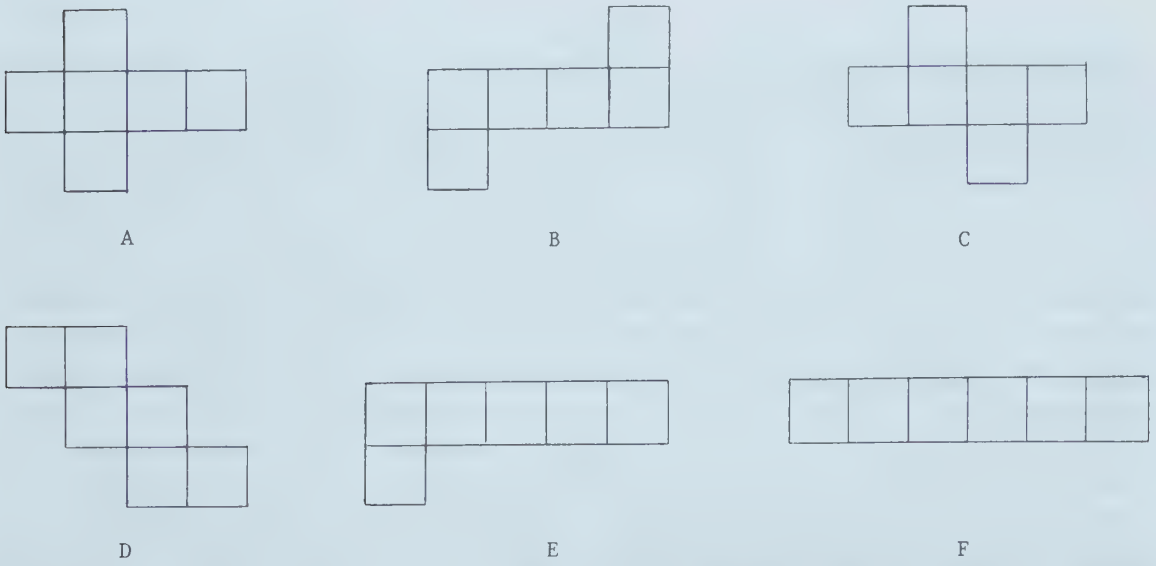
Once the data were on tape, the behaviors were transcribed in structured code to a prepared form and then carefully analysed. Sample transcriptions may be found in Little (1976).

The tasks associated with the problem apparatus described above were as follows:

Cube

The child was shown the assembled Plexiglas-Velcro cube and asked what he called the shape. Whatever name the child chose to associate with the shape was used in subsequent questions. He was shown how to disassemble the cube, then asked to reassemble it. A wire model of a cube was on the table for reference but no effort was made to draw the child's attention to it. As soon as the child had mastered the mechanics of assembly and disassembly, he was presented with the layouts in Figure 1 one after the other in the order shown.

FIGURE 1
ALTERNATE CUBE LAYOUTS



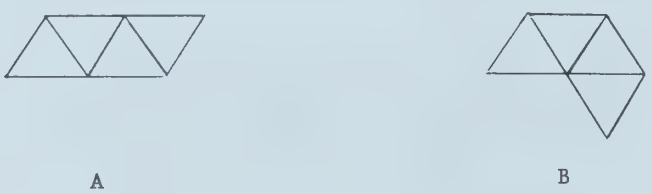
As each was presented, the child was asked if he thought the particular pattern would fold into a cube. An attempt was made by the interviewer to elicit a prediction from the child before folding began, but if the child showed any resistance, he was allowed to proceed with the task of folding.

Children who were unsuccessful in folding the first two shapes were permitted to abandon the remainder of the tasks. Layouts E and F could not be folded unless some change was made in the arrangement. The child was asked to reorganize the squares so that he could make the cube.

Tetrahedron

As soon as the six tasks with the cube were completed, the child was shown the four Plexiglas-Velcro equilateral triangle shapes and asked if he could put them together to make a box. A wire network of the same shape with the same dimensions was placed on the table in front of the child. If he needed assistance in constructing a tetrahedron, it was given to him. Then the two layouts in Figure 2 were presented successively in the order shown and the child was asked if he could fold each one to make a box. A prediction was expected, but if the child resisted, he was permitted to proceed with folding.

FIGURE 2
ALTERNATE TETRAHEDRON LAYOUTS



Dodecahedron

This shape was presented to the child in assembled form and after the child had examined it, he was asked to take it apart so it would lie flat on the table. The child was then asked to reassemble the shape. There was no wire model provided in this case. If necessary, the interviewer helped to hold up the sides of the incomplete form for the child.

Results

Observations of children's behavior in the shape-folding tasks will be divided into three sections: one for the cube, one for the tetrahedron, and one for the dodecahedron. The reader should keep in mind that these are observations carefully made on a small sample of 60 children. These children were in the age range three to eight years and were not randomly selected. There were the same number of children in each age range. It is not the purpose here to present exhaustive tabular data. Such data has been provided by Little (1976). This report is concerned with the qualitative nature of children's behavior rather than with reporting quantitative information.

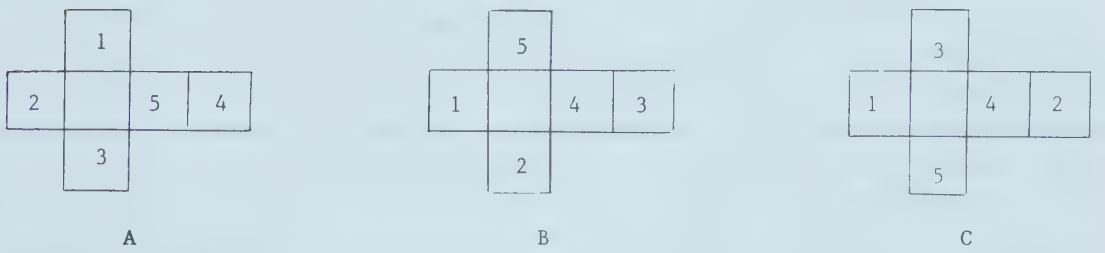
Cube

Even three-year-olds were able to construct a cube from a complicated looking two-dimensional layout. Nine out of 10 readily fit the elements of the cube corner-to-corner and edge-to-edge. Two three-year-olds and a six-year-old misinterpreted the question and piled the elements one on top of the other to make a "wallet," but 70% or more of the children correctly interpreted the tasks and successfully folded the cube. Although the older

children needed less assistance than did the younger ones, there was at least one child in each age group who needed some kind of assistance from the interviewer to complete the task.

Despite the rather intricate series of folds, turns, and fits, most children appeared to have developed some systematic procedure for handling the tasks. For instance, the most frequently used procedure for folding shape A was that shown in Figure 3 (A). The numerals indicate the order in which the elements were joined. As indicated, they would join elements 1, 2, and 3 to form kind of half box and then close it up by lifting and folding up 4, and then lifting 4 and 5. There were less systematic procedures used, of course. A few children folded in what appeared to be completely random order. Some younger children tended to work from both ends simultaneously in what appeared to be a global bringing together of the elements. These behaviors manifested themselves as indicated in Figure 3 (B) and (C). Eighteen of the three-, four-, and five-year-olds used either of these procedures while only three of the six-, seven-, and eight-year-old children employed the procedures. Only four out of the 60 children used a procedure that would start out with an unstable structure, i.e., a tunnel. As age increased, children tended to use more productive procedures.

FIGURE 3
FREQUENTLY USED CUBE PROCEDURES



Before children were permitted to proceed with the folding, they were asked to make a prediction about whether or not they thought a layout would fold into a cube. Roughly 50% of the children refused to predict. The percentage decreased somewhat with age, but only 6 out of the 10 eight-year-olds would readily make predictions. This prediction behavior, or lack of it, applied to all the layouts. Further, this behavior did not change as children had several cube layout experiences.

Of those children who would make predictions, most were correct, with the percentage of correct responses increasing slightly with age.

There are interesting observations of the behavior of children when passed from the four foldable layouts to the first and then to then second unfoldable layouts. Only one child younger than seven was able to predict correctly that shape E, the first unfoldable, had that property. However, the unfoldability of shape F was correctly predicted by 30 to 40% of the children up to age six and by the far the majority of the older children. Indeed, all eight of the eight-year-olds who made a prediction on shape F made a correct prediction.

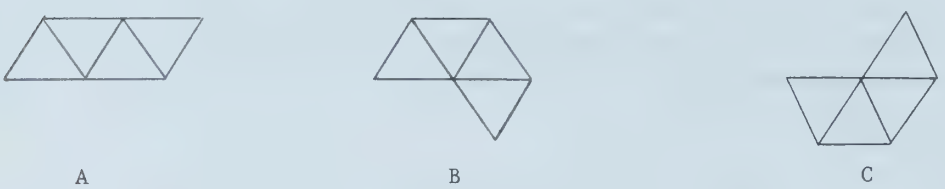
Once children found that layout E and layout F were unfoldable, they were asked to modify the layout so that it would fold. About half the

children readily modified layout E into foldable form and three-quarters were able to do so with layout F.

Tetrahedron

Although to an adult the folding of four triangles into a tetrahedron may appear to be a simple task, it was not so for these children. They found it much harder to make than the cube. When they were shown four separate Velcro-Plexiglass triangles and asked to put them together to form a box, 28 of the 60 could do so. Eighty percent of the children could construct a tetrahedron from the layout shown in Figure 4 (A). However, when asked to modify the layout shown in Figure 4 (B) so that it would fold into a tetrahedron, only 20% could do so.

FIGURE 4
FREQUENTLY USED TETRAHEDRON PROCEDURES



When asked to predict the foldability of the two layouts for the tetrahedron, there was a dramatic lack of response. Three-year-olds and eight-year-olds were the only age categories apparently willing to make predictions in the situations. About two out of three children in these categories would predict. For the layout in Figure 4 (C), none of the five-year-olds would make a prediction. Prediction responses among four-, five-, and seven-year-olds was not much better.

The nonrectilinear nature of the fit of the triangles necessary in constructing the tetrahedron seemed to be the main source of difficulty for these children. They would almost invariably align the triangles perpendicular to each other. The construction appeared often to be the result of random movements resulting finally in correct fits.

Dodecahedron

The solution to this task was more age-dependent than were the solutions for the cube and tetrahedron tasks. Eight out of the 15 children who successfully dismantled and rebuilt the dodecahedron were eight-year-olds.

There were two distinct observable behaviors in children when they were asked to take the dodecahedron apart. Thirty-four of the subjects completely detached the elements of the dodecahedron. The remaining 26 created a flat layout with no element separate from the total layout.

Again, about half the children who were asked to predict refused to do so. In the dedecahedron task, however, only 34 of the children were asked to predict.

Conclusions

1. The geometric problems posed for this sample, especially those involving the cube, seemed to be appropriate for children aged three to eight. The

children were able to gain appropriate *physical experience* and "solve the problem" by constructing the desired model.

2. The younger children, particularly, did not seem to gain *mathematico-logical experience* from th pproblems. They were less able to cope with unfoldable shapes than were older children (eight-year-olds). Although most children were good builders, the younger children tended to use less efficient folding procedures, probably indicating a lesser or different use of analysis.
3. A majority of the children in this sample, including nearly half of the older children (seven- and eight-year-olds), indicated a lack of operational control over the problems in that they refused to predict the foldability of the various layouts. This willingness and accuracy of prediction changed somewhat with age. The eight-year-olds seemed most nearly in control of difficult situations, e.g., unfoldable cube layouts and the dodecahedron problem.
4. The noncube problems presented perceptual and conceptual problems to many students. Part of this probably was due to lack of familiarity with the noncube objects. However, inability to work with nonrectilinear lines seemed a major cause of problems.

The curriculum builder, in developing geometric experiences for young children, should expect them to be motivated and willing workers. However, it should not be expected that children, especially before the age of seven or eight, will go beyond physical experience with geometric objects.

Although all the questions posed at the outset have not been answered definitively, there are some comments that should be made. In the first place, realistic problems can be created which will provide instructional experience for many children. Second, it is possible to observe and classify problem-solving behaviors of children and these behaviors seem to be age-related. This research does not, however, give definitive answers to transfer effects nor has it shed much light on the process that enables the child to "mathematize" his environment.

The purpose of the research was to gather and analyse carefully young children's reactions to selected geometric problem-solving situations. Conclusions 1 to 4 above were not looked for in advance. Hence this research and its data, while generating and supporting these conclusions, were not explicitly designed to test these conclusions. This is the work of further research.

This research was supported by Canada Council research grants S73-0488 and S74-1206.

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The Alberta Journal of Educational Research *Vol. XXIII, No. 1, March, 1977*

SHELLEY PHILLIPS
University of New South Wales

The Contributions of L. S. Vygotsky to Cognitive Psychology

An examination of Vygotsky's theory shows close affinity with western developmental-type cognitive psychologies. The compatibility of the two approaches inevitably grows out of the similarity of their basic assumptions. For example, in both approaches the Darwinian and functionalist influence is paramount, the study of cognitive processes is seen as a worthwhile scientific endeavour, and there is an anti-behaviourist stance. Vygotsky figured strongly in the demise of behaviourism and the rewriting of psychology in the Soviet Union. His ideas are now basic to Soviet cognitive psychology. Apart from discussion of these points, examination of Vygotsky's work reveals many promising concepts which could be of interest to psychologists generally, although his contributions have not been treated extensively in western psychological literature. (Dr. Phillips is at the School of Education, University of New South Wales in Kensington, Australia.)

How often, despite the revelations of the post-Sputnikian period of reappraisal, do we hear Soviet psychology described as "behaviourist"? While there are many and varied uses of this term, typically it is used in this connection in the pragmatic sense and in the tradition of J. B. Watson. To the average Soviet psychologist, behaviourism in this style contradicts and strikes at his basic philosophy, yet this description of Soviet psychology has become a convention among western psychologists. In fact, behaviourism enjoyed its heyday in Soviet psychology some fifty years ago in the twenties; since then Soviet psychology has become progressively more cognitively oriented. It also has much in common with the developmental psychologies which dominated the psychological scene in Europe and America in the early decades of this century and which are lately regaining popularity in western countries. Pavlov was long ago reinterpreted in the marxist context to contribute to a psychology in which the study of consciousness of cognitive is central.

The role of L. S. Vygotsky in putting the study of cognition and thinking at the centre of Soviet psychology is paramount. His contributions to a psychological theory of cognition are worth examination, not only to put the record straight about Soviet psychology, but because Vygotsky's ideas and research are interesting in themselves and are not fully treated in our literature. Unfortunately, Vygotsky was a psychologist for not much more than a dozen years before he died of tuberculosis in 1934 at the age of 38, and much of what follows is but a brief sketch for a cognitive theory. The potentialities have not been fully exploited and are worthy of more attention by researchers in this area.

Influence of Lenin

When Vygotsky entered the psychological field in the Soviet Union in the early years after the revolution, it was dominated by the reflexology of Bekhterev. Like Watson, Bekhterev (1933) believed the processes of consciousness or cognition can never be part of scientific investigation. Lenin, as head of the Soviet government at the time, was critical of Bekhterev's theories which he regarded as being in fundamental opposition to the philosophy of Marx and Engel which, together with his own writings, became the marxism-leninism which later formed the foundation of all aspects of Soviet science and politics, including psychology.

Briefly, marxism-leninism takes the study of consciousness or cognition very seriously and expects psychology to do likewise. Like many western psychologies, it states that psychic of cognitive processes cannot be reduced to physical, chemical, or physiological laws. As in western genetic psychologies, development in history, society, and the individual is seen as taking place through the dialectical process and qualitative change; development proceeds through a hierarchy of stages, each with its own special characteristics. Each transition to a new level of development constitutes a qualitative change which arises from an accumulation of changes in the previous stage; these changes, in their synthesis, completely change the nature of their own functions and organisations. Thus nothing can be considered singly; the study of interrelationships of the whole is essential. Since marxism-leninism stresses interrelationships in scientific study, it is opposed to the specificity which is an aspect of the pragmatic approach to science, and that style of behaviourism and neo-behaviourism which studies the learning of simple habits, maze running, pin ball throwing, or the reinforcement of single aspects of classroom behaviours. There is another important point which is often misrepresented in traditional views of marxism. According to Marx, man is a product of his environment, but *not* in a purely passive way. Marx was critical of mechanistic-materialistic theories of human development, and believed that by acting on the external world and changing it, man changed his own nature (Marx, 1935).

Many of marxism-leninism's basic concepts about the processes of development and change thus show a strong Darwinian influence, and have an affinity with the way these processes are described in some branches of biology or chemistry and the genetic style psychologies. The theories of John Dewey, James Mark Baldwin, Maria Montessori, and Jean Piaget are examples. Thus, when Vygotsky worked toward adapting Soviet psychology

to marxism-leninism, he was laying the foundations for an approach which is most familiar to a particular group of western developmental and cognitive psychologists. This approach is the antithesis of Watsonian and pragmatic style behaviourism.

Cognitive Psychology's Struggle

Vygotsky's battle to give the study of cognitive processes a central place in Soviet psychology is very similar to that fought by cognitive psychologists in the west since the middle decades of this century. His solutions and outcomes are often similar. Sometimes they are different and this difference suggests some novel research approaches for western cognitive psychologists. First, there is the grappling with the question of whether the pragmatic methodological divisions and compartmentalisations typical of behavourism are suitable for the study of cognition and development. Can learning and cognition be reduced to simple habits? Is learning and cognition an additive and chaining process of habit formation? Secondly, there is the much larger question of whether development and learning can be separated for the purposes of study. In the west, since Thorndike, we have witnessed the separation of learning theory and developmental psychology. The behaviourists and neo-behaviourists have favoured the study of simple learning tasks in the laboratory in keeping with their methodological view of science, and have downgraded or avoided the more complex developmental processes as a study.

An Interactionist View of Learning and Development

Vygotsky (1962) came out in favour of an interactionist view of learning and development; his views, while compatible with marxism-leninism, have much in common with the work of contemporary western developmental psychologists. His first conclusions and demonstrations of the usefulness of this approach came from the practicalities of his own research and, in particular, from his studies of aphasia, the affection of the speech zone which disturbs processes of perception, voluntary attention, logical memory, and discriminatory and directional behaviour. Here he found it more useful to study functions and relationships between functions, rather than utilise habits as the units of study. For instance, in the early years of childhood, sense and perceptual functions are central; as these functions interlink, so sensori-motor thought or a higher level of intellectual functioning emerges. Later sensori-motor thought comes under the influence of a new function, namely language, and the child learns to classify, code, and think in a much swifter and more organised fashion than when he was dependent on his percepts and senses alone, although basically thought grew out of these processes.

With the advent of language, there is a qualitatively new stage of cognitive functioning which changes the old relation between perception and the senses. This, Vygotsky concluded, is why a lesion in the occipital parts of the cerebral cortex in an adult leads to comparatively limited disturbance of perception and does not affect vocal processes of intellectual activity. But if a similar localised lesion of the occipital parts of the brain occurs in early childhood, it leads to massive mental retardation. At this

stage, focal lesions destroy the sensory basis for the development of language and later verbal or abstract thought.

Vygotsky, being a dialectical materialist and a Darwinian developmentalist, is here stressing the qualitative difference between the thought of the child and the adult. In fact, what he is saying at the neurological level is substantiating what Piaget has to say at the level of organisation of knowledge. According to behaviourism, said Vygotsky (1963), one and the same mechanism underlies the formation of habits, whether in the adult or the child. But there are essential developmental differences between the process of an adult learning, for example, to use a typewriter, ride a bicycle, or play tennis, and the processes of a school age child learning written speech, arithmetic, and natural science. Learning to use a typewriter represents the establishment of a number of habits which in themselves do not change an adult's mental traits. Learning of this kind makes use of an already elaborated and completed course of development and, precisely because of this, contributes very little to general development. But the process of learning to talk, read, and write calls forth a very different and much more complex course of developmental processes and the advent of these processes signifies a general change in the child's mental organisations. Vygotsky hypothesised that these changes are interlaced with the development of the central nervous system, and that learning stimulates the internal processes of development. He advocated that the rise and fall of these internal lines of development be studied in conjunction with developmental changes in the course of school learning. The notion is exciting. Unfortunately, because of Vygotsky's early death, like many of his ideas this was but hypothesis although his students and associates, such as Leontiev, Galperin, Elkonin, and Luria, have extended his work in this area. Unfortunately, also, the concept of the dialectical process, while it has had explanatory usefulness in chemistry and biology, needs much more elaboration in psychological theory. In Vygotsky's description given above, it is but an intuitive idea.

The Zone of Potential Development

In Vygotsky's second demonstration of the interaction of learning and development, there are some interesting differences from western approaches. Where western educational psychology has been extensively influenced by the old Herbartian tradition of readiness of the Piagetian concepts of assimilation and accommodation (development can do without learning), or the even more conservative maturational view (learning follows development), Vygotsky offered the zone of potential development. He rejected the view that the child develops through gradual and slow assimilation of changes. His observations led him to believe that the essence of cultural development consisted of a clash between the developed cultural forms of behaviours which the child encounters and the primitive forms which characterise his own behaviours. Cognitive development arises from the child's social interaction with those around him and collective activity leads him into realms which he cannot attain at the level of individual functioning. In his experiments Vygotsky found that young children can imitate, under adult guidance, a number of actions in collective activity which they cannot achieve independently. Vygotsky (1963) called this

divergence, between the level of performing tasks which are accessible under guidance with adult help and the level of performing tasks accessible to independent activity, the zone of the child's potential development.

The idea of the zone of potential development clashes drastically with the assumptions of the mental testing movement, which became traditional in the west. Intelligence tests can only determine the present and independent level of mental development, and educators tend to regard this as the limit which the child cannot transcend. Teaching is geared accordingly and to the yesterday of the child's development. But Vygotsky's theory of the zone of potential development holds that the only good teaching is that which outpaces development. The teacher should orient himself to what the child can achieve under collective activity, not simply to what he can do independently.

The zone of potential development which relates to collective activity in family and school does have certain variations in contemporary western cognitive and developmental theories. Piaget, for one, stresses social relations as producing qualitative changes in the child's development. For example, interactions and clashes with the varying points of view of his peers obliges the child to see himself from the point of view of others and is significant in the development of the concept of self, moral judgments, and the course from heteronomy to autonomy.

Social Interaction

In stressing the role of collective activity in cognitive development, Vygotsky once more found the experimental units and procedures of the behaviourists inadequate. Instead of stimuli and response at the experimental level, he worked with more global categories such as "social influences" and "social interactions." For example, he examined the history of the pointing gesture (1966). At the beginning it is merely an unsuccessful grasping movement aimed at an object. When the mother interprets this as a pointing gesture, the situation essentially changes. The pointing gesture becomes a gesture for others. When the child associates the unsuccessful grasping movement with the entire objective situation, he begins to treat this movement as a pointing gesture. Here the function of the movement itself changes: from a direct movement directed towards an object, it becomes directed towards another person—a means of communication. The child is the last to realise the full purport of his own gesture, since meaning and function are created first by the objective situation and then by the people surrounding the child. Thus, relations expressed in cognitive processes were at one time real relations among people. We also become ourselves through others, and this rule applies not only to the personality as a whole, but also to the history of every individual function. The extension here of George Mead's theory of how the concept of self emerges is clear. The idea also owes much to that of Mark Baldwin and, together with these two theories, Vygotsky's description is one of the early attempts to demonstrate concretely the relationship between external and internal behaviour.

The Role of Language and Significates

The Mediated Regulation of Behaviour

Vygotsky's holistic view of brain functioning and his view of the role of collective activity in cognitive processes must be held constantly in mind when discussing his views on the role of language and significates in human consciousness. While studying the effects of Parkinson's disease, in which affliction of the subcortical motor ganglions leads to disturbances of voluntary motion. Vygotsky noticed that patients suffering from this disease, although unable to step across a smooth floor, can go upstairs well. Vygotsky believed that this had to do with mediated regulation of behaviour by the undamaged cortex. When Vygotsky suggested that the patient throw cards on the floor and step across them, the patient walked without difficulty across the floor. Vygotsky interpreted this as the patient having created new additional stimuli in the external medium and performing in the mediated way the tasks which he was incapable of doing directly (Luria, 1934).

Thus, Vygotsky demonstrated that the use of signs could be used to form new functional systems to reconstruct the work of a sick brain and compensate for an existing defect. In this vein, Vygotsky did a number of experiments on mediated memorisation, in which a series of words were memorised with the aid of a series of auxiliary signals such as pictures of words. These aids were shown to extend the memory. In other experiments, Vygotsky found that if the child at the more primitive stages of thought is faced with a problem above his natural capacities, he will utilise extraneous objects, knots in string, etc., as signs to help in the solution.

Vygotsky quite honestly stated that he did not know how the process of signification actually works, other than by saying it involved "mastery of one's behaviour," which is a mediated process and which he felt sure could ultimately be explained by natural laws without resorting to spiritual factors such as "the will" in the sense that it was traditionally used in Vygotsky's student days. The concepts of mastery of behaviour and such constantly recur throughout twentieth century descriptions of thought processes. They have served, as in Vygotsky's system, to shift the emphasis from spiritually to materially based self-control, and are an important aspect of the development of twentieth century research into the psychology of thought. Unfortunately, apart from offering the possibility of a material explanation, they merely replaced one inexplicable concept for another.

The important role that signs, signals, and language play in Vygotsky's theory owes much to Pavlov. In fact, Vygotsky was the first psychologist in the Soviet Union to use Pavlov's ideas in a cognitive theory, but Vygotsky's views on the development of language have been well discussed elsewhere (Schmidt, 1973).

Concepts

Vygotsky's study of concepts demonstrates once again his dissatisfaction with stimulus and response as units for experimental work and his preference for social processes, functions, structure, and systems as the basis for analysis. For example, it was simple experiments by Vygotsky which looked at the early stages of the development of concepts via the process of

mediation and demonstrated the now well known observation that children "explain" the names of objects by their attributes. According to them, an animal is called "cow" because it has horns, "calf" because its horns are small, "dog" because it is small and has no horns. An exchange of names would mean an exchange of the characteristic feature of the object, so inseparable is the connection between them in the child's mind. The structure of speech does not mirror conceptual thought, and grammar precedes logic (Vygotsky, 1962).

Vygotsky was inevitably critical of experimental studies of concept formation which either concentrated on the verbal definitions of children or required children to abstract common traits. He preferred the then new experimental approach of one of his contemporaries, Clark Hull, the American neo-behaviourist, who set up artificial concepts for subjects to learn by attaching a nonsense word to a particular combination of object attributes for which no ready concept or word exists. The advantage, as he saw it, was that the solution of the problem does not presuppose previous experience or knowledge on the part of the subject. Where Vygotsky's approach differs from Hull's neo-behaviourism is that, as indicated earlier, he was not interested in stimulus and response alone but in the investigation of the functional conditions of concept formation.

The stages of development of concepts as given by Vygotsky utilise, in part, work derived from Piaget and Claparède and are remarkably similar to Inhelder's more recent descriptions. There is free use of Pavlov's concepts of connections, analysis, synthesis, and generalisation, and the concept of quantitatively different stages is basic. According to Vygotsky, the young child takes the first step toward concept formation when he puts together a number of objects in unorganised heaps, in order to solve a problem which adults normally solve by forming a new concept. At this stage, the child tends to merge the most diverse elements into one unarticulated image on the basis of some chance impression. He mistakes his own subjective interpretations for real bonds between objects. This trial and error grouping, Claparède and, later, Piaget called syncretic thought.

During the next stage, the composition of the group is determined largely by the spatial position of the objects. Later the child groups things according to bonds actually existing between the objects, but these are based on concrete or factually present connections, not logical unity. This Vygotsky labelled as thinking in complexes. Then comes what Vygotsky called "chain complexes," i.e., the child starts by collecting according to one trait and then his mind switches to another. The decisive attribute keeps changing. The single trait is not abstracted; it depends upon the perceptually concrete. The diffuse complex is a result of unlimited generalisation in his mind. The pseudo-complex is a transitional stage when the child appears to use the word correctly as a classification, but at first it has, in fact, all the tendencies of complexes.

The principle function of complexes is to establish bonds and relationships. It creates a basis for later generalisations. Synthesis is not as yet combined with analysis. There is an overabundance of connections and weakness in abstracting elements. Later the child can group on the basis of single attributes. The traits once abstracted, remain stable. These are

potential concepts. A concept emerges only when the abstracted traits are synthesised anew.

Thus, at a time when the behaviourists were presenting the first experimental examinations of concepts, Vygotsky offered an alternative to their associationist views. Concepts, he said, do not develop as a result of summing traits, but constantly alternate between the particular and the general. Concept formation is a process in which all elementary mental functions participate in specific combinations. The development is furthered and guided by the use of words as the means of actively centering attention, of abstracting certain traits, synthesising them, and symbolising them by a sign.

Spontaneous and Scientific Concepts

Borrowing in part from Claparède and Piaget, while at the same time adapting psychological theory to marxism-leninism, Vygotsky decided that concepts were of two kinds, spontaneous and scientific. Children who can tie a knot or build a house, but who cannot describe how they did it, have not yet learned to isolate and relate facts. Their concepts are spontaneous. Once they are aware of the activity of their minds and can abstract true relationships, they operate with scientific concepts. Vygotsky's spontaneous concepts bear a close relationship to Piaget's definition of concrete thinking, an aspect of which is its limited classificatory ability and, in fact, Vygotsky (1962) stated that the cardinal difference between spontaneous and scientific concepts is the absence of system.

Spontaneous and scientific concepts interact in many ways, and it is this interaction which is essential to the growth of thought. The spontaneous concept prepares the way for the scientific. For example, historical concepts can begin to develop only when the child's everyday concept of the past is sufficiently differentiated, and when his own life and the life of those around him can be fitted into the elementary generalisation of in the past and now. His geographic and sociological concepts must grow out of the simple scheme "here and elsewhere."

Scientific concepts, in turn, supply a variety of structures for the upward development of the child's spontaneous concepts toward conscious and deliberate use. The development of a scientific concept begins with a verbal definition. It starts its life in the child's mind at the level that his spontaneous concepts reach later. A child's everyday concept, such as "brother," is saturated with experience. yet when he is asked to solve an abstract problem such as how many brothers his brother has, he becomes confused. On the other hand, though he can correctly answer questions about "slavery," "exploitation," or "civil war," these concepts are schematic and lack the rich content derived from personal experience. They are filled in gradually, in the course of further school work and reading. One might say that the development of the child's spontaneous concepts proceeds upward and the development of his scientific concepts, downward to a more elementary and concrete level (Vygotsky, 1962).

Vygotsky was particularly interested in the relationship between instruction or teaching and spontaneous and scientific concepts. He believed that school instruction induces the generalising kind of perception and thus

plays a decisive role in making the child conscious of his own mental processes. Reflective consciousness comes to the children through the medium of scientific concepts and the processes whereby they learn their hierarchical interrelationships.

In the scientific concepts that the child acquires in school, the relationship to an object is mediated from the start by some other concept. The very notion of scientific concept implies a certain position in relation to other concepts, i.e., a place within a system of concepts. Thus Vygotsky (1962) saw, as does Piaget, thought developing according to increasing development of generalisations built upon generalisations of the preceding level. The following example may illustrate the function of varying degrees of generality in the emergence of a system. A child learns the word "flower" and, shortly afterwards, the word "rose". For a long time the concept "flower," though more widely applicable than "rose," cannot be said to be more general for the child. It does not include and subordinate "rose"—the two are interchangeable and juxtaposed. When "flower" becomes generalised, the relationship of "flower" and "rose," as well as of "flower" and other subordinate concepts, also changes in the child's mind. A system is taking shape. Passing beyond earlier stages and the generalising of attributes which define various objects, the child reaches a stage where certain aspects of these objects can be abstracted and generalised into ideas of number, for example, while at the next stage, algebraic concepts may be used to represent abstractions and generalisations of certain aspects of number. Each of these stages signifies a new departure and a new and higher plane of thought.

Vygotsky's Status

To elaborate upon the application and extensions of Vygotsky's theory in contemporary Soviet psychology is an enormous subject in itself. Nor has a detailed account been given of his strivings and clashes, his fall and rise in popularity in the Soviet Union. That is also a lengthy topic, but a few brief comments may be of interest. During the twenties, when Bekhterev was popular and Yenchman, Frolov, Blonski, and others were advocating that psychology be replaced by physiology, the Ukrainian Commissariat of Education, at one stage, decided that reflexology was to serve as the basis for the establishment of scientific pedagogy and did away with all psychology for a limited time. In this period, a few articles and books appeared in which reflexology was condemned and the rapproachment between psychology and marxism-leninism was attempted, but theirs and Vygotsky's role at this time was somewhat similar to the role occupied by Piaget among the American behaviourists and neo-behavourists from the late thirties to the fifties. It was not until the First All Union Congress for the Study of Human Behaviour in January, 1930, that measures were officially taken for introducing dialectics into all behavioural sciences, although it had been done earlier in other sciences. This conference officially established the principle of the irreducibility of psychic events to the laws of physiology. Vygotsky's work was influential in this achievement.

However, once the battle against behaviourism was won, Vygotsky's theories began to have difficulties in another direction. They were criticised because they did not always conform to the marxist-leninist line as it was

interpreted in the early years between the late thirties and the Pavlovian conference. Two years after his death, Vygotsky's book, *Language and Thought of the Child*, was officially suppressed and did not reappear until 1956 (Vygotsky, 1962). Why this happened is not clear but an official comment on Vygotsky states:

> He tried to explain the human psyche as a product of human development, but in so doing he made a dualist juxtaposition of "cultural and natural" development and treated the historical development of the psyche abstractly and outside the class struggle. (Maxwell, 1962, p. 562.)

Despite this and similar criticisms, Vygotsky's contribution appears never to have been wholly ignored. Anan'ev's article in 1948, which seems to summarise the position of Soviet psychology during and after the war, stated that research into thought and speech in that period comprised one of the central places in Soviet psychology, and she included Vygotsky in her summary of such work. The present status of Vygotsky in Soviet psychology is considerable as can be seen by the frequent references of his work in contemporary studies.

Implications of Vygotsky's Work for Psychological Research

For the prospective doctoral student and other researchers, Vygotsky is a virtual treasure trove of as yet unexplored topics. In particular, there are two interesting areas which could do with more extensive research in the west. First, there is the zone of potential development. Most teachers are not overly conversant with the developmental stages of their pupils, are subject rather than person oriented, and see achievement as a competitive and individual matter. Schools are still oriented to the concept of maturation, readiness, and testing the child's present intake. Classroom application of Vygotsky's ideas on the zone of potential development and collective activity, and empirical testing of the possibilities and outcomes seems long overdue, even if only as a means of examining traditional practices more objectively.

Secondly, Vygotsky combined physiological and neurological studies with the study of the development of thought. His idea that learning stimulates the internal process of neurological developments and that these two be studied in conjunction has received limited attention in the west. Surely it is clear that thought has something to do with the brain. At the same time as the structures of thought processes are being examined, is it not logical that such research be in close touch with research at the neurological and biochemical level? The distinct and pragmatic division of research in these two areas which has been characteristic of the twentieth century has obviously not been fruitful. We still do not know what thought processes are.

In conclusion, some current research which has been inspired by some of Vygotsky's tentative formulations is worth perusal. His views on the role of early social interaction in the development of language and thought are currently being examined by J. S. Bruner (1975) and his students at Oxford. Bruner has been much influenced by Soviet psychologists and his interchange with Vygotsky's associates has been considerable.

On the Soviet scene, Vygotsky-type experiments by L. F. Obuchova (1966)

on the function of auxiliary or mediating signs are of interest. She demonstrated that if a new mediational way of thinking were created by means of which the child could make concrete comparisons of an object before and after its dimensions were changed, conservation could be developed earlier than Piaget had suggested. Mediation was through a third object operating as a standard or measurement and, in this way, children were taught to measure length, volume, area, and weight of objects. They began to talk about changes in dimensions which made quantities appear different when, in reality, they were not. They were taught to single out different characteristics of objects and then to distinguish dimensions in which one object differed from the other and dimensions in which they were identical.

Another experiment by Teplenkaya (1966) which looked at the forming, in six to seven-year-olds, of the logical structures of class membership and relationships between classes and subclasses is also based on Vygotsky's work. It consisted of analysing the tasks to be learned into the necessary algorythm of action without losing the relationships involved in the task as a whole. These were the units for study and were conceived in the same spirit as Vygotsky's use of word meaning as the unit of verbal thought. After the analysis, the children were involved in performing the selected actions which dealt with all aspects of constant and variable features of classes such as, for example, the putting of boxes of different sizes within each other, the drawing or measuring of different parameters of the objects involved, and so on. Then the children were led through the subsequent stages seen as necessary for the development of mental actions as outlined by Vygotsky, namely logical and verbal expression of the activities involved, silent thinking, and consolidation and internalisation of action with appropriate practice.

The experiments demonstrated that children could be taught logical actions involved in class membership as early as six or seven years of age, when by traditional procedures, these are not normally acquired until twelve or thirteen years of age. Teplenkaya (1966) concluded that the usual level for forming such concepts reflected only the course of the process of learning in concrete historical conditions of teaching rather than the age potentialities of children and the necessary logic of the process of learning.

These are but a few of innumerable experiments which point to the rich source of research ideas offered by Vygotsky's work.

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The Alberta Journal of Educational Research *Vol. XXIII, No. 1, March, 1977*

J. C. POWELL
University of Windsor

The Developmental Sequence of Cognition as Revealed by Wrong Answers

Gorham's Proverbs Test (1957) was administered to 550 children from three different schools in grades 3 to 8 inclusive. The highest and the lowest scoring 16% were interviewed to determine the reasons for the wrong answers given. Wrong answers were then grouped by a two-stage cluster analysis procedure and the resulting clusters used to develop subtest scores. The correlation matrix (of right and wrong answers) was reordered into a Simplex pattern. The resulting pattern clearly supported the possibility of a developmental sequence. The clusters were then interpreted, using the transcribed reported reasons for answers as a guide. These interpretations produced a logical description of the apparent developmental sequence when placed in the same order as revealed by the Simplex arrangement. A comparison was made between this order and the hierarchical sequence found elsewhere with mature adults (Powell, 1970). The rank order correlation between the orders of the common elements in the two studies was .86, suggesting a strong relationship and supporting the empirical validity of the order obtained. (Dr. Powell is Assistant Professor in the Faculty of Education at the University of Windsor.)

About fifteen years ago, the present author noticed a tendency for consistency in the selection of wrong answers on multiple choice tests. Specifically, a number of students tended to choose several wrong answers in common from several different items. Also, asking specific students why they chose these wrong answers often assisted in the planning of instruction.

These observations led to the question, "Are wrong answers really blind guesses as is commonly held?" A careful study using Gorham's Proverbs Test (1957) with adults revealed that this assumption is false (Powell, 1968).

Within the logic of test analysis, it is not sufficient that wrong answers be systematically selected. If answers are either right or wrong, then knowing that an answer is wrong adds no new information to the observation than an answer is not right. Such a "linear dependency" assumption is commonly held concerning wrong answers on multiple choice tests. This linear dependency question was explored (Powell & Isbister, 1974), using 387 adults and a different test, and was found to be false. With more than one alternative from which to choose, at least some wrong answers load on factors which contain no right answers; that is, some are not linearly dependent.

This latter discovery led to the question, "Do wrong answers contain achievement information?" The next study in the series (Powell, 1970) used the same test as in Powell and Isbister (1974). This study with 277 mature adults explored this question, with three conclusions:

1. Wrong answers may be better predictors of present and future performance than right answers (i.e., they contributed more of the variance, using stepwise multiple regression, to the prediction equation). Performance is defined in terms of obtained scores on course related achievement tests.
2. Wrong answers appear to be ordered in a hierarchy which parallels Bloom's *Taxonomy* (1956) and which influences the level of functioning of the questions in which they are embedded as distractors.
3. When the results of wrong and right answers are combined, the most stable (in cross-validation terms) prediction of present and future success is obtained.

Research up to this present study into the nature of behavior related to wrong answers may be summarized as follows:

1. The common assumption that a person writing a multiple choice test always either knows the answer or guesses blindly is false.
2. The related assumption that all wrong answers are linearly dependent upon the right answers is false.
3. The assumption that wrong answers contain no useful information (in a predictive sense) about achievement is false.

These conclusions imply that answer selection is much more complex than a know-guess dichotomy would seem to suggest. Do people choose answers based upon some systematic aspect of their personality? The "yes" answer to this question can be supported if a developmental sequence of wrong answer selection can be uncovered. It is to this latter issue, the exploration for a developmental sequence, that this present study turns.

Method

Instrument

Gorham's Proverbs Test (1957), in its multiple choice version, involves 40 proverbs for each of which four possible translations are offered. Although it also has clinical uses, its primary value with normal subjects is as a short, broad-spectrum, reading comprehension test. Norms are offered in the manual for the range of grade 5 through adult for the Abstract scale. Norms are not given for the Concrete scale. The wrong answer interpretations reported here were developed in the present study.

Procedure

This test was administered to 550 children in grades 3 to 8 inclusive (approximately 90 children in each grade) from three different schools. The five highest scoring and the five lowest scoring children from each grade level of each school were interviewed to determine the reasons they had for the selection of the wrong answer. This interview followed the administration of the tests which were scored immediately so that the children could be brought to the examining room usually within minutes of the completion of the test. Two trained interviewers were employed in each school. In no case were the reasons collected more than two hours later than the test administration. This procedure was used to minimize the effects of forgetting.

A frequency count of the selection of each of the four alternatives partitioned by age was produced. The proportion of selection of each wrong alternative by age was calculated. It was observed that particular alternatives tended to have the highest proportion of selection at particular age levels. These were grouped together and further analyzed so that alternatives which were significantly correlated were placed into definitive clusters. A unique group was also generated from some alternatives which were bimodal in their highest proportions.

Thus age-level related groups of wrong alternatives were placed into homogeneous clusters. Those clusters with five or more members were treated as subtests and the answers of all 550 children were rescored. Those which formed clusters of less than five were dropped from the analysis. Thus the present study accounts for 82 of the 101 possible wrong answers. The resulting 14 profile scores (including the two right answer scales) were correlated and the resulting correlation matrix was rearranged into the Simplex order as defined by Guttman (1944).

These clusters were also classified using the reported reasons for selection, so that if a hierarchy emerged, its developmental properties could be examined.

Results

The first question considered was whether or not a hierachical ordering was evident. Table 1 gives the results of this analysis. The categories are coded by age (10y stands for 10 years old). If more than one subscore set was present for a particular age, these were assigned an arbitrary number (8y4 stands for the fourth subset among the 8-year-olds) to distinguish among them.

It is evident from the arrangement of subtest scores in Table 1 that a clearly definable age-dependent hierarchy was found among these data. In fact, not a single age order displacement occurs. The majority of correlations are significant ($p < .05$ for $r = .083$) and these clearly support the hierarchy. Most of the significant correlations are low, once again providing evidence nonsupportive of the "linear dependency" assumption.

The reasons given within each cluster for the selection of the particular alternatives in it tended to be logically equivalent between 50 and 60% of the reasons reported.

Proceeding along the hierarchy as given by the Simplex order from low to high, the interpretation given in Table 2 emerged.

TABLE 1
SIMPLEX[a] ORDER OF THE CORRELATIONAL ANALYSIS OF ALL VARIABLES

Right Answer Scales	Wrong Answer Scales	14y+	13y	12y	Bimodal	11y	10y	9y2	9y1	8y3	8y1	Concrete	8y2	8y4
ABSTRACT		.25[c]	.06	.00	-.20	.05	-.22	-.25	-.44	-.46	-.48	-.73	-.60	-.31
	14y+[b]		.07	.01	-.01	-.09	-.16	-.11	-.18	-.14	-.16	-.22	-.15	-.16
	13y			-.07	.04	.05	-.01	-.08	-.10	-.10	-.16	-.18	-.14	-.05
	12y				.05	.06	.01	-.16	-.08	-.05	.00	-.02	-.06	-.04
	Bimodal					.01	.09	.02	-.00	-.01	.02	-.04	.04	-.05
	11y						.14	.06	-.08	-.10	-.24	-.27	-.24	-.07
	10y							.17	.03	-.01	-.09	-.10	-.01	-.08
	9y2								.05	-.06	.06	.06	.12	-.02
	9y1									.15	.02	.16	.23	.04
	8y3										.36	-.14	.26	.06
	8y1											.37	.26	.22
CONCRETE													.39	.21
	8y2													.16

[a] The simplex arrangement involves ordering correlations in increasing magnitude vertically upward and horizontally to the left.

[b] To give a reasonable group size, children of 14, 15, and 16 years of age were combined into one group.

[c] Underlined correlations are significant at $p \leq .05$.

TABLE 2
INTERPRETATION OF WRONG ANSWER CLUSTERS

General Stages	Wrong Answer Scales	Interpretation	No. of Alternatives in Scale
Personalized interpretations			
	8y4	Partial translations	5
	8y2	Isolated responses	15
	8y1	Redefining terms	9
	8y3	Personalized answers	7
Literalized interpretations			
	9y1	Word associations	8
	9y2	Literal reductions	5
	10y	Literalizations	9
Figurative interpretations			
	11y	Oversimplifications	6
	Bimodal	Irrelevancies	10
	12y	Transpositions	4
	13y	Overgeneralization	6
	14y+	Simplifications	7

The names for these wrong answer categories were assigned as a result of the interpretive analysis conducted in the study.

These 12 classes of response use 82 of the 101 possible wrong responses. There are 19 answers classified as concrete correct answers and 40 as

abstract correct answers. Thus this procedure uses 141 of the 160 (4 × 40) alternatives on the test, or 88% of all possible answers.

Three general classes of wrong answer emerged. First, personalized interpretations all involved the typical egocentric behavior described by Piaget in which the child responds within the framework of her or his own limited personal experience and is unable to entertain externalized reference points. Second, literalized interpretations all involve external reference to the denotive rather than the connotive meanings of the words used. Third, the child in this stage shows greater or lesser facility in the use of the connotative or figurative meanings of words.

A detailed description of the basis for the interpretation of the types of error identified is shown in Table 3. These are given in the same order as in Table 2. Each description contains (1) the name assigned to this type of response by the present researcher; (2) a behaviorally based definition for this type of response derived from the reasons reported by the examinees within each type; (3) an illustration of the behavior with a typical reason

TABLE 3(a)
TYPES OF ERROR IDENTIFIED IN STUDY
PART I: PERSONALIZED INTERPRETATIONS

Wrong Answer Scale	8y4	8y2	8y1	8y3
Classification				
Interpretation Assigned	Partial translation	Isolated responses	Redefining terms	Personalization
Behavioral Definition	Only part of the proverb is translated into personal experience.	Explanation of answer selection related to distractor only.	The meaning of the proverb is changed by using alternate meanings for key words.	The child relates both the stem and the foil to the same personal experience, often correctly.
Illustration				
Proverb	THE HOT COAL BURNS, THE COLD ONE BLACKENS	THERE'S MANY A SLIP TWIXT (between) THE CUP AND THE LIP	GOLD GOES IN AT ANY GATE EXCEPT HEAVEN'S	DON'T THROW GOOD MONEY AFTER BAD
Translation Chosen	Leave dangerous things alone.	Don't talk too much while eating.	Anyone would take money.	Don't waste money.
Reason Given	You might get burned badly.	You'll bother people if you talk too much.	I think people should work for their MONEY. (i.e., take = steal).	Because if you waste all your money you will end up poor.
Overall Consistency (Per cent)				
	54.9	56.7	59.4	50.9

TABLE 3(b)
TYPES OF ERROR IDENTIFIED IN STUDY
PART II: LITERALIZED INTERPRETATIONS

Wrong Answer Scale	9y1	9y2	10y
Classification			
Interpretation Assigned	Word associations	Literal reduction	Literalization
Behavioral Definition	The child makes a correct association between a word or two in the stem and in the foil and ignores the rest of the problem.	The child extracts most but not all of the literal meaning of the basic communication.	The child translates both stem and foils into a literal statement in his/her own words and matches these literal statements for his answer.
Illustration			
Proverb	THE MORE COST, THE MORE HONOR	DON'T SWAP (TRADE) HORSES WHEN CROSSING A STREAM	ALL IS NOT GOLD THAT GLITTERS
Translation Chosen	Good things have to be paid for in some way.	Don't try something until you're able to do it.	Some things may fool you.
Reason Given	Good things cost more.	You might fall in.	A lot of stones look alike.
Overall Consistency (Per Cent)	53.7	57.8	57.1

reported; and (4) the proportion of all respondents in this type whose reported reasons are consistent with the behavioral description. Table 3 emphasizes the three stages in development uncovered among these data in this study.

Problems of order occur at both ends of this sequence. Since the study was conducted in May, the 8-year-old group represents the youngest grade 3 students, about half of whom had become 9 years old during the year. With no reference point lower, it is difficult to establish the order in which the four 8-year-old subscores should be reported. Similarly, since the 14-, 15-, and 16-year-olds are the oldest grade 8 students, the manner in which Oversimplification (with the 11-year-olds) and Simplification (with 14-year-olds) is different is not entirely clear.

It is possible, however, to produce a general two-way classification for these wrong answers. This system is presented in Table 4 and presents the suggestion that particular error types may recur within the general framework of the modifications in orientation that the different stages seem to imply.

When the classified sequence found in this study is rank order correlated with the equivalent categories in the hierarchy found elsewhere among mature adults (Powell, 1970), the correlation is .86. It is evident from this

TABLE 3(c)
TYPES OF ERROR IDENTIFIED IN STUDY
PART III: FIGURATIVE INTERPRETATIONS

Wrong Answer Scale	11y	Bimodal	12y	13y	14y+
Classification					
Interpretation Assigned	Over-simplification	Irrelevancy	Transposition	Over-generalization	Simplification
Behavioral Definition	The child correctly translates most, but not all, of the figurative meaning.	The child chooses a true statement which is unrelated to the generally accepted meaning of the passage.	The child changes substantially the figurative meaning of the proverbs.	The child chooses an answer which goes beyond the scope of the usual figurative meaning.	The child correctly interprets most but not all of the usual figurative meaning of the passage. To distinguish this class of responponses from the 11y one, it is necessary to think in terms of more abstract and/or nearer correctness for this class.
Illustration					
Proverb	RICHES SERVE A WISE MAN BUT COMMAND A FOOL	IT NEVER RAINS BUT IT POURS	THE GRASS IS ALWAYS GREENER IN THE OTHER FELLOW'S YARD	TOO MANY COOKS SPOIL THE BROTH	SPEECH IS THE PICTURE OF THE MIND
Translation Chosen	Don't let money go to your head.	A little is as bad as a lot.	Don't stay in one place to do something.	You'll have too many ideas.	Words paint pictures in your mind.
Reason Given	Money can't (shouldn't) run your life.	If you do something wrong, it's still wrong, even if you do just a little thing or something real bad.	Because if you stay in one place all the time you'll never know what the other place is like.	If you have too many people, they won't be able to decide what to do. do.	When you're reading, sometimes you can picture what the author's telling you.
Overall Consistency (Per Cent)	57.1	59.4	52.9	53.7	62.7

TABLE 4
DEVELOPMENTAL SEQUENCE OF WRONG ANSWERS

	Level of Abstraction of Interpretation		
General Strategy	Personalized	Literalized	Figurative
Fragmentation	Isolated responses	Word associations	Oversimplification
Reduction	Partial translation	Literal reductions	Simplification
Rearrangement	Redefined terms	Transpositions	(Inversions)
Extension	(Continuations)	(Extrapolations)	Overgeneralizations
Transition	[Concrete answers]	Irrelevancies	
Balancing	Personalities	Literalizations	[Abstract answers]

Age Scale	7	8	9	10	11	12	13	14

( ) Not found in this study.

[ ] Correct answer subtests.

observation that there is a high level of consistency in the findings between these two independent studies which used different instruments and different age groups. There was also observed to be a perfect agreement for equivalent classes with the error sequence reported in the manual, *Raven's Coloured Progressive Matrices* (1956). Thus this sequence would seem largely to recapitulate the findings of other independent studies on different populations.

Conclusions

The major characteristics of these newly observed classes of behaviors are fairly evident from the findings reported in this study. Children seem to move from a personalizing stage where they relate all problems to their personal experience through a stage when they take meanings literally before they begin to deal figuratively with meaning in any systematic manner.

It is therefore reasonable to report that this study has discovered a previously unreported aspect of the developmental sequence of behaviors in that wrong answers seem to parallel the observations made by Piaget and Vygotsky, as reported by Stewin and Martin (1974) among others, with respect to the general learning sequence.

Since this study was cross-sectional rather than longitudinal, there is no way of telling if all children go through all these phases. Hence the apparent recurring cycle reported in Tables 3 and 4 may not actually exist. If these recurrences do exist, it may imply that there may be specific thinking styles which particular children characteristically use. The possibility would explain the predictive power of wrong answers observed elsewhere (Powell, 1970). Also, there may be particular transitions through which a child passes and optimal progress takes place.

In any case, the discovery that a type of behavior not usually considered in research studies (namely wrong answers) follows a similar developmental sequence to the one commonly observed in other phases and stage-oriented research has interesting implications for further research. The principal observation here suggests that the way a person interprets and attacks a problem determines the answer selected. In this case, learning may not be a simple linear accumulation of information and skills as suggested by Gagné (1965).

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J. KIRMAN
The University of Alberta

The Use of Infra-red False Color Satellite Images By Grades 3, 4, and 5 Pupils and Teachers

Landsat images are pictures of the surface of the earth produced by satellites. The timeliness and accuracy of these images, colloquially referred to as maps, are of value to social studies teachers. Until now, no research had been undertaken to determine if elementary level children could work with these images, or if elementary level teachers could teach with them. This study is an exploratory attempt to generate preliminary data with a limited sample of participants to determine the feasibility of further definitive research on the topic—in this case, to make an initial judgment whether or not elementary school children and their teachers in this project can deal with infra-red false color Landsat images. The tentative conclusions are that the teachers in this project are able to teach with infra-red Landsat images and children in the project are able to learn about infra-red Landsat images and derive information from them. (Dr. Kirman is Professor of Social Studies in the Department of Elementary Education, The University of Alberta.)

Today, through the services of space technology, maps of the earth's surface are made by orbiting satellites. These maps, known as Landsat and Seasat images (land satellite and sea satellite images respectively) and formerly known as ERTS (Earth Resources Technology Satellite) images, were first obtained when ERTS-1 was launched, July 23, 1972. A second such satellite was launched January 23, 1975. These satellites follow each other on a nine-day interval (Bricker & Campbell, 1975). These satellites are in a near polar orbit, 560 miles high, each covering almost all of the earth's surface every eighteen days (National Aeronautics and Space Administration, 1973 [NASA]). Each satellite picture contains an area of 13,000 square miles, resolving features not smaller than 30 meters (NASA, 1973).

The accuracy and timeliness of these images, as well as their uses are of extreme value:

Agricultural fields, surface water, types of land forms, patterns of urban

> development and other changes in the earth's surface from natural or man-made causes are now observed on a regular basis . . . . ERTS-1 also carries a Data Collection System (DCS) that acquires water quality, rainfall, snow depth and seismic activity information from remotely located sites in North America. (NASA, 1973, p. 2)

The scale of a Landsat image is 1:1,000,000; however, these images can be enlarged without loss of detail up to a scale of 1:250,000. Several images are produced in various visible and nonvisible light spectrum bands both in black and white and in composite false color (NASA).

These images are perhaps more informative and accurate than any hand drawn map based upon previous cartographic technology. Among possible uses of the images are: comparative growth of communities, land use, nature of vegetation, evidence of pollution, examination of geologic patterns.

With a device called a density slicer, even more uses are presented, from the identification of specific mineral and vegetable surface features to the quality of the surface soil (Bricker & Campbell, 1975). However, this latter item is a most expensive and sophisticated tool, presently out of financial reach of almost all elementary and secondary school systems.

Given the nature of these Landsat images and the potential for classroom instruction that might evolve, the following questions were raised:

1. Can elementary level children obtain data from Landsat images?
2. How would elementary teachers use Landsat images, assuming children on these grade levels are capable of dealing with Landsat images?

An examination of the literature shows no studies of the use of Landsat images with elementary level children.

B. E. Kingston (1969) used aerial photographs with children in grades one, two, and three. The maps used on each grade level were to a maximum scale of 1:31,800. Kingston found that these children could read vertical photographs, but had difficulty in interpreting them without previous teaching.

K. G. Dueck (1969), in a study similar to Kingston's utilizing aerial photographs of the same scale with children in grades four, five, and six, found that these children could read aerial photographs; there was no problem with scale; interpretation of these maps was not correlated with map reading ability and age; and that grade 5 performed better than grade 4 or 6.

Concerning the capacity of elementary level children to deal with maps, Brown and others (1970), in a study in English schools, examined boys and girls aged eight to fifteen years old. Some suggested results infer difficulty for younger children in map reading (Descriptor Paragraph).

In a study by Blaut (1971) of children aged three to twelve dealing with "mapping and free environmental behavior" among other items, mapping behavior was found to be developed in preschool children.

The Kingston, Dueck, and Blaut studies appear to confirm that elementary level children are capable of dealing with aspects of aerial photographs and maps. While the Brown study does not specifically deal with aerial photographs, it appears to suggest difficulty in the comprehension of certain aspects of maps by elementary level children. However, items such as the types of maps, the nature of the research, socioeconomic levels,

as well as the nature of the English social studies curricula in comparison with those of North America may also have some bearing on the differences between this study and the others.

Definitions

Landsat Image: a representation of the land surface of the earth produced with the aid of an orbiting satellite, often referred to as a map, both terms being interchangeably used by teachers who find "map" a more familiar term at this time.

Infra-red False Color: that portion of the spectrum corresponding to infra-red, and used to delineate vegetation (green) on Landsat images.

Landsat: Land satellites, scanning the land surfaces of the earth.

Seasat: Sea satellites, scanning the ocean surfaces of the earth.

ERTS: Earth Resources Technology Satellite. Formerly the name of Landsat satellites.

Visible Light Spectrum; that portion of the light spectrum visible to the human eye.

Composite False Color: color produced on Landsat images composed of data derived from different satellite spectrum scans of the same area.

Non Visible Light Spectrum: that portion of the light spectrum not visible to the human eye.

Polar Orbit: the orbit of a satellite where the path is over the earth's poles.

Vertical Aerial Photographs: photographs taken in an aircraft of the surface of the earth directly below the aircraft.

Rationale

The rationale for undertaking this study with elementary level children is that Landsat images are a new social studies resource, and the prime researcher was curious as to whether or not it could be used by young children.

In addition, while it might be presumed that secondary level students would probably be able to cope with many aspects of Landsat images, no such presumption can be freely made for the elementary level students, given the magnitude of the scale involved. Hence, if such relatively young children could cope with these new images, the potential for early introduction of them might be discerned.

Method

Instruments

Three instruments were used in this exploratory project: teacher-made tests for each class; an "Interview Questions for Children on Landsat Maps" administered and prepared by the prime researcher; teacher questionnaire prepared by the prime researcher.

The instruments are subject to the following:

1. No validated instrument has been found that can test the abilities of elementary level school children to read infra-red false color Landsat images.

2. No previous studies have been found utilizing Landsat images with elementary level school children in order to provide a comparative study to extrapolate testing tools for this study.
3. The purposes of the study are to determine if the participating elementary level school children are capable of deriving information from infra-red false color Landsat images, and if their participating teachers can teach about them.

Thus, the teacher-made instruments would necessarily be:

1. Tentative rather than definitive;
2. Specific to this study, rather than general;
3. Designed to elicit a response unique to the teaching procedures of each class and the information taught;
4. Designed to elicit responses to Landsat image questions considered correct by each teacher.

Under these circumstances, the teacher-made instruments may be considered valid for their particular classes. Since these instruments are unique to these teachers and children and are not to be used again, the element of reliability appears not to enter into this consideration.

The "Interview Questions for Children on Landsat Maps," administered by the prime researcher, was used to elicit responses to questions based specifically on Landsat images. The object was to determine if children of varying abilities, using infra-red Landsat images different from those used in their class, were able to derive information from them and answer questions about them.

This instrument was designed specifically to generate tentative data on the ability of a select number of children of varying abilities to answer specific questions about infra-red Landsat images (vegetation and snow cover images). Since the questions were specific to the Landsat images in question and since the children appeared able to understand the questions and respond to them, it may be tentatively considered that this tool was valid for the purposes stated.

Since the questions are such that they may be applied to any infra-red false color Landsat images, the instrument may be tentatively considered as reliable for the purpose stated.

Research Questions

In order to determine if children on the grade 3, 4, and 5 level were capable of dealing with Landsat images, the following questions were formulated:

1. Can grade three, four and five teachers work with Landsat images in their planning for classroom activities?
2. Can grade three, four and five children understand what Landsat images are by deriving information from them?
3. Will grade three, four and five teachers be able to teach their students about Landsat images?
4. Will grade three, four and five teachers have to modify Landsat images in order to use them with their students?

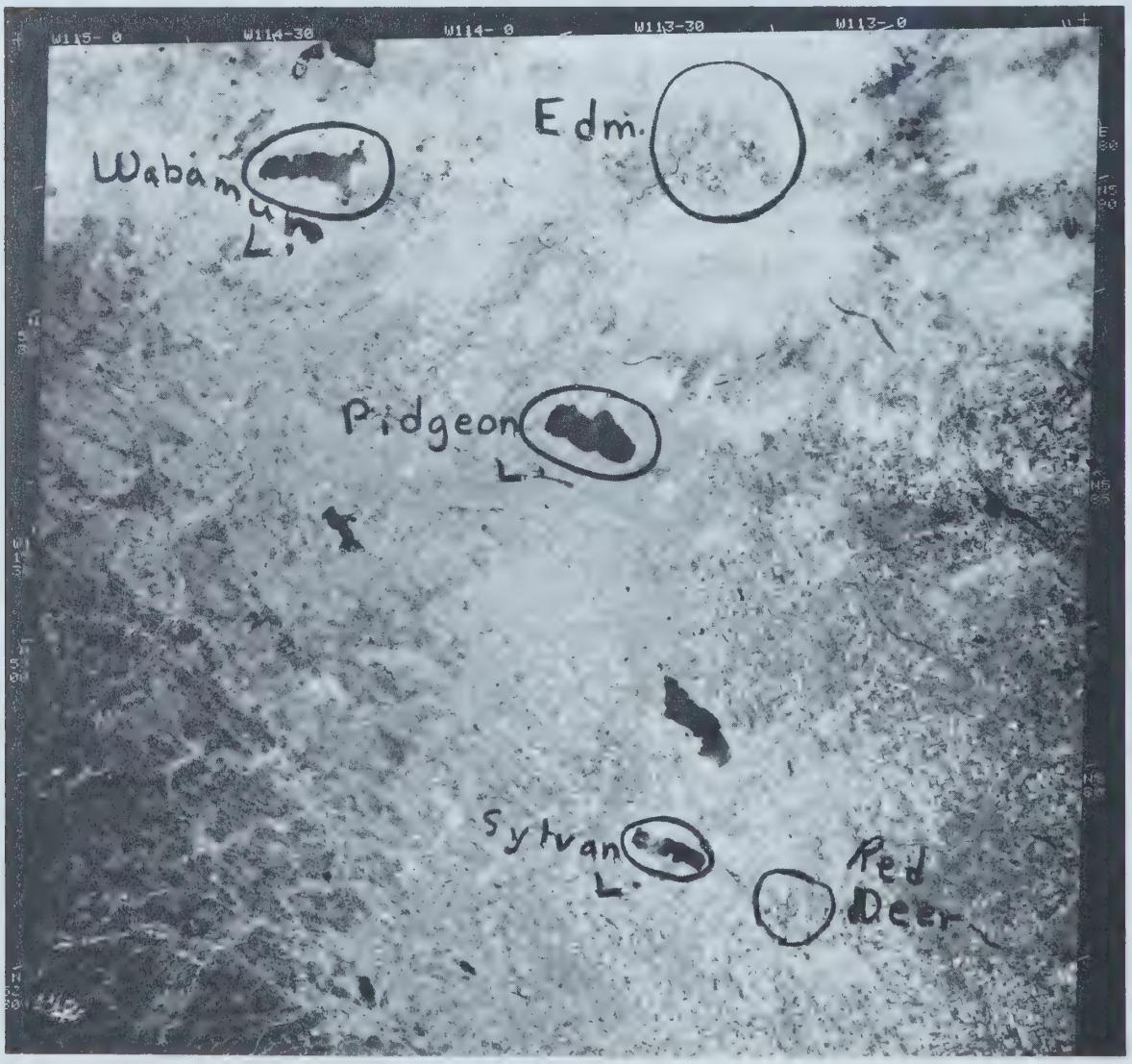
Subjects

The rationale for the use of Landsat images with grades three, four and five is that the Alberta social studies curriculum calls for community studies in grade three, Alberta in comparison with other regions of the world in grade four, and regional studies of Canada in grade five. These topics can lend themselves to the use of maps for classroom activities.

In cooperation with the Edmonton Separate School Board, one teacher and class on each grade level were selected by the school board's social studies supervisor on the basis of interest and ability. The teachers and students had no previous exposure to Landsat images. Prior to the classroom phase of this exploratory project, the teachers and research director met twice as a group. The first meeting was at the Alberta Remote Sensing Center in Edmonton for approximately one hour. There, they were instructed in interpreting Landsat images and in the technology involved in obtaining the image.

A second meeting was held for approximately one hour at the Separate School Board headquarters for a brain storming session on possible ways of

FIGURE 1
TYPICAL FALL LANDSAT IMAGE WITH GRADE 3 STUDENT NOTATIONS.



using the Landsat images in class. Teachers also received several National Aeronautics and Space Administration publications on Landsat images.

At the first meeting, it was determined that two Landsat images would be used: one with snow cover and one without. The teachers decided that infra-red false color might prove more effective with the children due to the attractiveness of the color and the apparently greater contrast between earth surface features than on any of the black and white images. Landsat images are not made in true color.

Classroom Materials

The images selected by the teachers were of the Edmonton Region. one was a fall image without snow cover; the other was a spring image with snow cover. Both images were of approximately the same area, with the spring image covering a more southwesterly area than the fall image. The size of the images was 18.2 cm × 18.4 cm each. Figure 1 shows a typical image complete with third-grader's notations.

Enough prints of the images were provided for two children to work on a single set. In addition, some magnifying glasses were provided. Each teacher had available an overhead projection size transparency of each image in infra-red false color, a class set of standard maps that included the area of the Landsat images, and an overhead projection transparency of the standard map with the approximate areas of the Landsat images marked on them. Black China markers were also provided for the children to mark the surface of the images.

Procedure

Since there were no studies on the use of these types of images with elementary school children, the teachers were asked to teach about them in the way they felt was best for their classes. The classes were heterogeneously grouped as shown in Table 1.

In order to allow for complete flexibility of class instruction and to avoid teaching to a test, no uniform written posttest of all the children was given. The teachers were requested to prepare an examination and evaluate their students following the classroom instruction phase, and to determine prior exposure to these types of images.

Following the classroom evaluation, the prime researcher orally interviewed three children on each grade level. Selected by the teachers, these children were considered above average, average, and below average. The teachers also received a questionnaire on their participation in the project. All data were submitted to an external examiner for review.

Classroom Phase

Prior to starting the instruction phase of the project, the teachers were asked to check the medical records to ascertain if any of the children had vision problems and to specially observe those who did.

Since there was no experience base concerning Landsat images on the elementary level, the teachers emphasized different aspects of them. Thus, the grades three and four teachers emphasized radiation that allows images

TABLE 1
SUBJECT DATA

		Mean	S.D.
Grade 3 (*N*=25: Male, 15; Female, 10)			
Reading Level		4.07	.800
I.Q. (Primary Mental Abilities Test)		108.5	9.88
Grade 4 (*N*=25: Male, 16; Female, 9)			
Reading Level		4.93	1.21
I.Q. (Lorge Thorndike)	Verbal	106	13.02
	Nonverbal	109.70	14.01
Grade 5 (*N*=19: Male, 12; Female, 7)			
Reading Level		4.42	1.00
I.Q. (Lorge Thorndike)	Verbal	91.31	13.91
	Nonverbal	87.25	14.19

to be made while the grade five teacher emphasized specific geographic features.

All teachers provided some background information on how the images were produced. The grade three and four teachers prepared some ditto sheets of National Aeronautics and Space Administration materials for distribution to the children, and had the students prepare a special folder for the Landsat activities. It may be noted that the grade three and four teachers were both at the same school. There was virtually no prior exposure of the students to satellite images, as determined by the teachers.

During the course of the project, the research director visited all classrooms a minimum of three times. Teachers were prepared and the students participated in an interested orderly manner. All classes were well organized. When not conducting a question and answer activity, the teachers moved among the students providing advice and guidance.

Class activities consisted of: basic factual instruction; questions and application of information to the images at hand; examining a single Landsat image first, usually the fall one, for surface features; examining the second image for these surface features; checking for differences between the fall and spring image; comparing the Landsat images with standard road maps (grade three did not use these maps, but examined the overhead projector transparency of the road map—there was a road map displayed on the back wall of the classroom during the entire project).

Teachers began working with the fall image first. Then when the children were able to work with it, the spring one was introduced. After examining the spring Landsat image and becoming familiar with it, the children were given both images to be used for comparative purposes. Table 2 indicates class variation between teaching time, period length, and number of instruction periods.

TABLE 2
TEACHING TIME, PERIOD LENGTH AND NUMBER

Grade	Hours of Teaching	Period Length	Instruction Periods
3	5	45 minutes	6 - consecutive with a double period later in the day, if necessary
4	4½	45 minutes	6 - consecutive
5	5½	30 minutes	11 - over a period of 16 days, with one lesson on any one day.

One aspect of the instruction was that the children were able to write and mark the surface of the Landsat images with easily erasable China markers. When the overhead transparency projector was used, children were encouraged to come to the screen and point out features being discussed or newly discovered.

In all classes, children worked in teams of two. The reason for this was to minimize expenses for the maps. A second benefit was that each child was able to interact with at least one other child.

Results

Teacher Evaluations

The teacher-made examinations differed greatly concerning content, number of questions, and manner of administration. However, specific questions in almost all tests could be designated either as interpreting the images or applying the images to a problem. In this way, a very rough measure could be obtained of the number of students able to interpret the images or apply the images to a problem. Table 3 shows that a large number of children in each grade appeared capable of interpreting some aspects of Landsat maps and that a large number of children in grades three and four appeared capable of applying Landsat maps to a problem.

Class scores varied, as shown in Table 4. However, by inspection the scores show that the children were able to cope with the examination questions and while some did have relatively lower grades than others in their classes, many scored quite high. In general, it appeared that the grade range roughly suggests the ability to deal with questions based on Landsat maps prepared by the teachers.

Interview Evaluation

Following the classroom phase of the project, the prime researcher interviewed three children on each grade level: above average, average, below average for the class as determined by their teachers. Each child was asked a series of 15 questions, 13 of which had one or more responses that could be graded as correct or incorrect. Based upon these 13 questions, there was a possible total of 20 correct answers.

The questions were based upon a fall and a spring Landsat image, and one question was based upon the Landsat images and a road map of the area

TABLE 3
DISCRIMINATING QUESTIONS FOR INTERPRETATION AND APPLICATION OF LANDSAT IMAGES

Interpretation

Grade 3

Question 6. What types of land surface are seen on these maps? Name them.

Full Credit 14 Half Credit 9 Total Credit 23

Grade 4

Question 5. What is the main thing to be seen when you look at any Landsat map?

Total Credit 13

Grade 5

Question 5. (one among a series of interpretive questions)
On this summer map, the large blue areas represent:
(a) rivers (b) lakes (c) forests (d) mountains.

Total Credit 19

Application

Grade 3

Question 9 (a). What can these ERTS maps tell farmers?

Full credit 14 Half Credit 4 Total Credit 18

(b). How can the maps help the Forestry Department or the lumberman?

Full credit 20 Half Credit 3 Total Credit 23

Grade 4

Question 6. Name three different groups who could use Landsat maps for their benefit?

Full Credit 8 Partial (2) 5 Partial (1) 3 Total Credit 16

Grade 5

Questions were mainly interpretive.

(Table 5). The images and map were of a different area than those used in the class. Question 10 of the series required the children to pick out a town on the Landsat images. No child was able to do this, due to the small size of the towns in the area, and this question may not constitute a valid measure of the children's capability to do this (Table 6).

Research question 2 regarding grade three, four, and five children's understanding of Landsat images and deriving information from them appears to be answered affirmatively. Both the teacher-made tests and the oral evaluation show that the children were able to derive information from the Landsat images. One notable discrepancy did occur. The mean of the teacher-made test grades were comparatively low for the grade four girls with relatively high I.Q.s and reading scores. In discussing this with the grade four teacher, it was noted that the girls were generally less enthusiastic

TABLE 4
SCORES FOR THE TEACHER-MADE TESTS

	Mean	S.D.	Range
Grade 3			
Class	78.1	13.73	45-100
Males	78.2	14.76	45-100
Females	78	12.95	65- 90
Grade 4			
Class	54.74	23.18	0-100
Males	57.5	22.61	30-100
Females	43.8	29.25	0- 80
Grade 5			
Class	69.1	12.02	44- 92
Males	69.8	15.20	44- 92
Females	68.6	4.86	60- 76

TABLE 5
INTERVIEW QUESTIONS FOR CHILDREN ON LANDSAT IMAGES

1. What are these? (Pointing to both Landsat images)
2. How were they made?
3. What are the differences between these two maps?
4. Can you tell if there are any growing plants on these maps? How?
5. Can you find a lake on both of these maps?
6. Can you find a river on both of these maps?
7. Can you find a road on both of these maps?
8. Can you find any clouds on both of these maps?
9. Can you find any farm land on both of these maps?
10. Can you find a town on both of these maps?
11. Here is a regular map of the land shown by the Landsat map. Find the town of High Level on this map. Now find High Level on a Landsat map.
12. What could people use these maps for?
13. Can you tell me anything else you know about these maps?
14. What else would you like to learn about these maps?
15. If you were in the lumber business, could Landsat maps help you? How?

about the map activities than were the boys, as evidenced both by classroom response and the amount of outside materials brought to class.

One item of data that could have been derived from this project was which of the two images was easier to work with, the vegetation cover or the snow cover. This was not done since any data would be misleading. This is

TABLE 6
DATA OF THE INTERVIEW EXAMINATION
(A = Above Average B = Average C = Below Average)

Grade	Age	Sex	I.Q.		Reading	Correct Responses	Percent
Grade 3							
A	7.3	M	N/A		4.8	13	.65
B	8.1	F	129		4.7	13	.65
C	8.1	M	109		2.7	13	.65
Grade 4			Verbal	Nonverbal			
A	9.4	M	112	131	6.2	12	.60
B	9.1	M	122	118	5.6	17	.85
C	8.11	F	108	115	4.9	5	.25
Grade 5							
A	10.3	F	114	111	5.8	13	.65
B[a]	9.9	F	N/A	N/A	5.3	8	.40
C	11.7	M	N/A	N/A	N.A	11	.55

[a] Teacher noted child as nervous and inattentive with family mental health and marital instability.

due to the variation in observation of specific features because of the intensity of the infra-red false color and contrast with nonvegetation varying from region to region, and whether or not inhabited areas or roads are cleared of snow in the winter. Thus, each region's Landsat images varying from season to season must be examined on their merits. However, it appears that greater contrast between ground cover and items of interest can promote easier identification of these items.

The data seemed consistent with Kingston's (1969) findings that youngsters in grade three can read vertical photographs, and that without previous teaching, there was some difficulty in vertical aerial photograph interpretation.

The data also appear to be consistent with Dueck's (1969) findings that there was no significant correlation between chronological age and map reading ability. Although due to the variation in class ability, experience of the teachers, and the differing approaches taken by the teachers in this project, this consistency may not be valid.

Since there appeared to be no problems concerning map scale, the project data seem consistent with Dueck's similar findings. While Dueck found grade five subjects to perform better than grade four or grade six subjects, the grade three subjects in this project appear to have performed better on their evaluations than the grade four or grade five children. This may possibly not be considered a valid comparison for the reasons noted above.

Conclusions and Recommendations

Research questions 1, 2, and 3 appear to be answered affirmatively for the participants in this project. Research question 4 appears to be answered negatively for the participants in this project.

Since children on the grade three, four, and five level seemed to be able to work with infra-red false color Landsat images to obtain data from them, it may be tentatively concluded that such Landsat images can be used on these levels. However, the extent to which children can apply Landsat image derived data to problems remains to be explored.

Teachers of grade three, four, and five children in this project appeared to be able to teach about Landsat images to their students. However, the level of instruction appeared related to the background knowledge of the teacher. It may be concluded that a more extensive program of instruction than was provided in this project is necessary to provide teachers with Landsat image background information.

Implications of this Project for Social Studies

The ability to work with Landsat images provides a new dimension of study. The Landsat images being continually made of the same areas every nine days can provide timely, accurate data on urban and rural development, pollution problems, agricultural conditions, as well as comparative examinations of almost any surface area of the planet.

In such studies, economic, sociological, and political as well as geographic implications of these images can be discussed with visual accuracy. Over a period of time, a historical examination of areas might be undertaken with a chronological series of images.

To reiterate, the important characteristic of Landsat images for social studies is their accuracy and timeliness. Presently, there are no other materials that can do the same or better.

Suggestions for Further Research

1. Is there a sex related difference regarding grade four students' interest and achievement with Landsat images?
2. Can children on grade three, four, and five levels work with the black and white Landsat images? If so, which types?

A more definitive project allowing greater scope for claims of effectiveness of using Landsat images with elementary school children might be undertaken with the following considerations:

1. A larger selection of students on each grade level: a minimum of three classes, or as many as needed to reach 100 students on each grade level.
2. All students to be as nearly as possible within the range of "average." If not, then as intellectually comparable as possible.
3. All students to be as nearly as possible within the same socioeconomic level.
4. All students to have "normal" reading levels. That is, no students with serious reading problems in the sample, if possible.
5. Participating teachers to be as comparable as possible to each other as to professional training, teaching experience, ability, and interest.
6. Participating teachers to follow specific teaching procedures on each grade level.
7. Teaching objectives to be specified before classroom phase is to begin.
8. All children to be pre- and post-tested, using uniform examinations for

all grade levels, and uniform examinations on specific grade levels where special circumstances relating to that grade level merit such examinations.

9. A thorough training program for participating teachers in teaching about Landsat images, and how these images are produced and used. Five hours is suggested for this phase, as a minimum.
10. External evaluation at all phases of the project.

This project was funded by a grant from the Alberta Advisory Committee for Educational Studies. The cooperation of Dr. Donald Massey, University of Alberta, as external examiner, and the Edmonton Separate School Board for its facilities is gratefully acknowledged.

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The Alberta Journal of Educational Research *Vol. XXIII, No. 1, March, 1977*

R. L. NOLL
State College Area Schools
D. J. WILLOWER
and
J. J. BARNETTE
The Pennsylvania State University

Teacher Self-Actualization and Pupil Control Ideology-Behavior Consistency

The hypothesis that teacher level of self-actualization would predict the consistency between teacher pupil control ideology and behavior was tested in this study. Data were gathered on the levels of self-actualization and pupil control ideologies of 84 teachers, and data were collected from students concerning the pupil control behavior of these teachers. The hypothesis was not rejected. Previous research that showed a positive relationship between teacher self-actualization and humanism in pupil control ideology was replicated with similar results. However, teacher self-actualization was not associated with humanism in pupil control behavior. (Dr. Noll is school psychologist, State College Area Schools, State College, Pennsylvania: Dr. Willower is professor of education and Dr. Barnette is assistant professor of education, The Pennsylvania State University.)

In a previous study (Jury, Willower & DeLacy, 1975) it was found that teacher level of self-actualization was directly related to teacher humanism in pupil control ideology. The present research is an effort to build upon that work. This article reports on an investigation of the relationship of teacher self-actualization and the consistency of teacher pupil control ideology and behavior.

The concept of self-actualization (SA) has been developed most fully by Maslow (1957, 1964, 1968, 1970, 1971). The self-actualizing person is one who, compared with others, makes full use of his capabilities, functions in an autonomous manner, lives in the present, and has a benevolent view of people and of life (Maslow, 1970).

The idea that pupil control is a key feature of the social system of the public school was one outcome of a field study (Willower & Jones, 1967; Willower, 1971) that led to a line of inquiry (Willower, 1975) on educator pupil control ideology (PCI) and pupil control behavior (PCB). In that work, both pupil control ideology and behavior were conceptualized on a humanistic-custodial continuum. Humanism stresses trust of pupils and self-discipline, while custodialism emphasizes distrust of pupils and imposed discipline.

Hypotheses

Three hypotheses were tested in this investigation. The major hypothesis predicted that there would be a direct relationship between teachers' levels of SA and the consistency of teachers' PCI and PCB. The rationale for this hypothesis was quite simple. The individual at a relatively high level of SA should be one who has satisfied basic needs, is positive toward others, and is autonomous and self-directed. Such a person is likely to behave in a manner consistent with his beliefs.

The second hypothesis was a replication of the research by Jury, Willower and DeLacy (1975) noted earlier. It stated that there would be a direct relationship between teachers' levels of SA and humanism in PCI. The third hypothesis tested was similar to the second, but it examined teacher PCB, not PCI. It posited a direct relationship between level of SA and humanism in PCB.

Method

Instruments

The Personal Orientation Inventory (Shostrom, 1968) was used as a measure of SA. It measures positive health or SA rather than pathology (Shostrom, 1964). The inventory consists of 150 paired items; the higher the score to a theoretical maximum of 150, the greater the level of SA. Test-retest reliabilities above .90 have been reported for this instrument, and it has been shown to differentiate between persons judged by clinical psychologists to be self-actualized and nonself-actualized (Shostrom, 1968).

Teacher beliefs and behavior were measured respectively by the PCI Form and the PCB Form. These devices are companion instruments in that both are based on the same humanistic-custodial continuum. Split-half reliabilities for the PCI Form ranged from .91 to .95, and it was shown to discriminate between teachers and schools judged to be humanistic or custodial (Willower, Eidell & Hoy, 1973). PCB Form reliability as estimated by Cronbach's alpha was .92. Item-scale correlations for the PCB Form averaged .81 and one-way analysis of variance indicated that the instrument differentiated among subjects while clustering within subjects (Helsel & Willower, 1974).

Both the PCI and PCB Forms consist of 20 items. The scoring range on each is from 20 to 100, the higher the score the more custodial the ideology or behavior. While the PCI Form is completed by the subject whose ideology is being tapped, the PCB Form is completed by students with their teacher as the object of response. A given teacher's PCB Form score is the mean of the PCB Form scores of the students in that teacher's class.

Sample and Procedure

The sample consisted of selected teachers and students in a single school district in the northeastern United States. The district's 11 elementary schools, two junior high schools and one senior high school serve a small city and its surrounding suburban-rural areas. The faculty of the school system approximated state averages for salary and years of teaching experience.

It was decided to gather data from all of the school district's fifth and sixth grade teachers at the elementary school level and all of the mathematics and social studies teachers at the secondary school level, as well as from the students of the fifth and sixth grade teachers and the students in one of the classes of the secondary school teachers. Fifth and sixth grade teachers were chosen since students at those grade levels would have no difficulty responding to the PCB Forms, and mathematics and social studies teachers were chosen because they represented major, but quite different, instructional areas. There were 49 fifth and sixth grade teachers in the district, and 47 participated in the study; there were 46 mathematics and social studies teachers, and 38 participated. A total of 2,068 students took part in the study.

Teachers were given the PCI Form and the Personal Orientation Inventory at grade or departmental meetings, and a date was set for the collection of these forms and the administration of the PCB Forms to students. However, a specific time or class period was not designated. This meant that the researcher's schedule rather than the teachers' choices dictated which of a given secondary school teacher's classes completed the PCB Forms on that teacher. However, this was a convenience procedure rather than a random one.

The response of one elementary teacher and of a number of students were incomplete; thus, the final sample used in the analyses consisted of 84 teachers, 46 at the elementary level and 38 at the secondary, and 2,044 students, an average of 24.3 per teacher.

Results

The major hypothesis tested stated that there would be a direct relationship between teachers' levels of SA and the consistency of teachers' PCI and PCB. The dependent variable, PCI-PCB consistency, was the absolute difference in PCI and PCB scores calculated after PCI and PCB raw scores had been converted to standard scores. Data on the several variables examined in the study are presented in Table 1.

The Pearson product-moment correlation coefficient between the teachers' SA scores and their difference scores was -.225. The minus sign was an artifact of the way consistency was measured; as SA scores increased, difference scores decreased. With 82 degrees of freedom, the correlation was significant at the .05 level. Hence, the major hypothesis was not rejected.

The second hypothesis predicted a direct relationship between teachers' levels of SA and humanism in PCI. The correlation of -.486 was significant beyond the .001 probability level, indicating that the hypothesis could not be

TABLE 1
TEACHER SA AND PUPIL CONTROL DATA ($N = 84$)

Variable	Score	SD
SA	102.1	10.9
PCI	52.2	8.8
PCB	48.4	9.6
PCI-PCB Standard score difference	10.4	7.1

rejected and that the earlier work of Jury, Willower and DeLacy (1975) was supported in this investigation.

The third hypothesis proposed a direct relationship between teachers' levels of SA and humanism in PCB. In this case the *r* of -.060 was not significant and the hypothesis was rejected.

In addition to the tests of these hypotheses, a number of other analyses were carried out. They included tests of the three hypotheses in subsamples of teachers, and comparisons of various mean scores for several categories of teachers. These are reported in detail in Noll (1976). Only those bearing on the hypotheses are noted here.

When the major hypothesis was tested separately within the teacher subsamples based on grade level, sex, and years of experience, it held up only in the case of teachers having more than five years' experience. For these 58 teachers, the correlation of -.278 was significant at the .05 level. In the case of the second hypothesis, the relationship between teacher SA and PCI held for every category examined. The correlations ranged from -.456 for elementary teachers to -.541 for the 33 male teachers in the sample. In contrast, none of the correlations between teacher SA and PCB were significant. In fact, the highest of these correlations, .287 for the 26 teachers having five years' or less experience, although not significant, was in the opposite direction of the prediction.

Discussion

Before discussing our findings, we wish to make the usual disclaimers. Although results were significant in several cases, correlations were moderate and the variance accounted for was limited. In other words, much of the variance in the several dependent variables is associated with unknown variables other than self-actualization. Also, the research utilized paper and pencil measures throughout with all the limitations of that medium. Finally, the sample was not a large one, a consideration that became more material when subsamples were examined.

Having expressed these cautions, we will take our findings at face value in order to offer some speculations concerning them. For the sample studied, there was a clear cut relationship between teacher SA and PCI, a modest relationship between teacher SA and PCI-PCB congruence, and no relationship between teacher SA and PCB.

The relationship between SA and PCI is one between orientations that can be considered internal to the individual. They are internal in the sense that there is no *necessary* connection between the orientations and behavior. That the more self-actualized teachers were more humanistic in PCI both in this and a previous study indicates complementary orientations. A self-actualized person tends to see people and the environment as relatively benign, and the self-actualized teacher is likely to view students as trustworthy and favor a humanistic control ideology. That internal orientations of this kind should complement one another makes sound theoretical sense.

When the major hypothesis guiding this investigation was tested, we found that more self-actualized teachers tended to be more consistent in their beliefs and behavior, specifically in terms of their beliefs and behavior regarding pupil control. This suggests that persons having higher levels of SA are less vulnerable to the organizational, peer group, and other pressures that commonly intervene to divorce beliefs and behavior, shaping behavior to fit situational demands. However, the strength of the relationship found between teacher level of SA and PCI-PCB consistency was only moderate. This could be interpreted to mean that the teachers in our sample adapted to the classroom environment by basing much of their pupil control behavior on situational pressures and particular circumstances, but that the more self-actualized teachers managed to maintain at least some consistency between beliefs and behavior.

The fact that there was no relationship between teachers' levels of SA and their PCB suggests adaptive behavior more strongly than did the modest results of the test of the major hypothesis. We conjecture that teachers' PCB is influenced to a degree by their attitudes, to a degree by organizational and social system demands, and to a degree by the realities of the work of teaching. That work requires that all teachers respond to such classroom realities as student questions, requests, and misbehavior, as well as manage a wide range of activities of a logistical kind. And we have not even mentioned the instructional aspect of teaching. It would seem that the setting within which teachers work is one characterized by a high level of demands, demands which markedly reduce leeway for the expression of teacher behavior. In any case, the interrelationships between personality, beliefs, behavior, and the demands of the organization, the social setting and the work itself are subtle and complex.

In summary, it was found that teachers who are more self-actualized tend to be more humanistic in PCI than their less self-actualized counterparts, and it was argued that this relationship stems in part at least from the association of two complementary orientations internal to the individual. It was found that teachers who are more self-actualized are more likely than their less self-actualized colleagues to be consistent in PCI and PCB. The speculation was advanced that the modest correlation that characterized this relationship meant that numerous forces effectively intervene to channel behavior in other than the direction dictated by one's beliefs, but that more self-actualized persons are somewhat less vulnerable to these influences than less self-actualized persons. Finally, no relationship was found between teacher SA and PCB, and it was conjectured that this indicates the extent to which social and organizational forces and the

character of the work of teaching itself impose demands upon behavior which even quite different individuals find compelling.

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S. J. H. McCANN
London, Ontario
and
R. J. FISHER
University of Saskatchewan

The Interactive Relationships of Teacher Directiveness and Student Authoritarianism and Dogmatism to Grades and Satisfaction

This study was designed to determine which of the interactions of teacher directiveness and student authoritarianism, teacher directiveness and student dogmatism, teacher authoritarianism and student authoritarianism, and teacher dogmatism and student dogmatism account for unique variance in grades and satisfaction. Six teachers and 174 students in grades 11, 12, and 13 English classes completed the F-Scale and the Dogmatism Scale. Students also completed a teacher satisfaction scale and the SPOTS teacher directiveness scale. Each student's English grade, IQ, sex, English teacher's sex, year, and academic program were determined from school records. Three dependent variables, grades, z-grades, and satisfaction were developed. Perceived teacher directiveness interacted with student authoritarianism in the determination of z-grades ($p < .05$), *and with student dogmatism in the determination of satisfaction* ($p < .01$). *These interaction effects remained significant when teacher directiveness was statistically controlled. Both interactions were related to grades,* $p < .01$ *and* $p < .05$ *respectively, but not when teacher directiveness was controlled. Perceived teacher directiveness appeared to be somewhat independent of actual teacher directiveness and was correlated with satisfaction* ($r = .34$, $p < .001$).

Researchers have spent considerable time and energy trying to delineate the factors which may enhance student performance and satisfaction in the classroom. One such line of research has been concerned with the relative effects of directive and nondirective teaching styles. In his approach to teaching, the directive teacher tends to be absolute, formal, and structured, while the nondirective teacher tends to be tentative, informal, and

unstructured. Tuckman (1968) views the directive teacher as one for whom extreme concern with order, procedure, and organization affects both the structure of the class and interpersonal relationships with the students. A directive teacher highly structures and plans the course and classroom activity, minimizes informal and group work (and even structures it when it is used), takes absolute responsibility for grades, places a premium on factual knowledge derived from absolute sources, minimizes students' opportunities to learn from their own mistakes, uses absolute and justifiable punishment, and maintains formal teacher-student relationships. A nondirective teacher exhibits the converse of these practices.

Several researchers have sought to demonstrate the superiority of either directive or nondirective teaching to foster greater learning or higher student morale, but the results have been largely inconsistent and inconclusive (Anderson, 1959; McKeachie, 1954; Weiss, Sales, & Bode, 1970). However, as Arlin (1975), Domino (1975), and Gardner (1974) have pointed out, if pupil characteristics are not considered in concert with teacher characteristics it may be falsely concluded that certain teacher variables have little effect upon the teaching outcome under investigation. Student characteristics may mediate the effects of teacher characteristics.

Tuckman (1968) and Weiss et al. (1970) suggested that the effects of teacher directiveness are mediated by student authoritarianism (Adorno, Frenkel-Brunswik, Levinson, & Sanford, 1950). Tuckman found that nonauthoritarian students expressed greater satisfaction with nondirective teachers while authoritarian students showed little differentiation in their level of satisfaction with one teaching style or the other, in a vocational high school sample. Similarly, nonauthoritarian students earned higher grades from nondirective teachers, but authoritarian students received similar grades under both styles. However, the interaction effects were only found in nonconventional courses and only attained the .10 level of significance.

Weiss et al. used teacher authoritarianism scores as indicators of directiveness to test the same general hypothesis as Tuckman. It is generally assumed that authoritarian teachers use directive teaching styles (McGee, 1955; Maney, 1959). In an academic high school sample, Weiss et al. found that authoritarian students were particularly dissatisfied with nonauthoritarian teachers while satisfaction for nonauthoritarian students was not related to teacher authoritarianism. The findings with grades as the dependent variable were parallel to those with satisfaction, even when the effects of intelligence were taken into account. Again, the interaction effects were only significant at the .10 level.

There is some evidence that dogmatic teachers also tend to be directive (Ager, 1970; Stevenson, 1970; Tosi, Quaranta, & Frumkin, 1968). Dogmatism (Rokeach, 1960) can be regarded as a "general authoritarianism" not oriented to any particular political ideology (Barker, 1963).

The interaction effects of student dogmatism and teacher directiveness apparently have not been researched in any direct way. However, Cohen (1971), in an exploration of tutor-student relationships, found that dogmatic students preferred that the tutor direct studies rather than provide opportunities for the student to direct himself.

Ford (1969) and Appel (1974) postulated that student dogmatism mediates the effects of teacher dogmatism on achievement. In each study, no significant differences were found between the various combinations of teachers and students ranked high and low on the dogmatism dimension.

The Pensacola Z Survey (Jones, 1957) is also purported to measure general authoritarianism. It is comprised of five subscales: rigidity, anxiety, hostility, dependency, and heteronomy. Way (1973) administered the scale to a sample of instructors and students in freshman English. Students, ranked high or low on rigidity, anxiety, and hostility paired with instructors ranked similarly on these subscales, achieved at a higher level than did any group of students with instructors ranked medium. Way pointed out that "although the simple effects reported in the study are not synonymous with interaction effects, they do strongly suggest such interactions" (p. 233).

In summary, the interactive relationships of teacher directiveness and student authoritarianism, and teacher authoritarianism and student authoritarianism, to performance and satisfaction have received only statistically insignificant support; the interactive relationship of teacher directiveness and student dogmatism to either performance or satisfaction has not been specifically researched; the interactive relationship of teacher dogmatism and student dogmatism to performance has been subjected to only quasi interaction analysis, while the relationship to satisfaction has received no attention.

Even if significant interaction effects were reported for any of the four combinations of teacher and student characteristics it would be difficult to assess their validity since teacher directiveness, authoritarianism, and dogmatism appear to be interrelated. Without appropriate controls it might be falsely concluded that teacher personality rather than teaching behavior is the crucial factor, or with controls the "significant" interaction effect might vanish.

The present study was designed to determine which of the relevant interaction effects—teacher directiveness and student authoritarianism, teacher directiveness and student dogmatism, teacher authoritarianism and student authoritarianism, and teacher dogmatism and student dogmatism—account for unique variance in grades and satisfaction.

Intelligence, teacher sex, student sex, and the match of teacher and student sex were considered as covariates in this study since, in addition to the generally accepted relationship between intelligence and achievement, research suggests that teacher ratings are related to intelligence (e.g., Appel, 1974), and achievement and satisfaction are related to teacher sex (e.g., Arnold, 1968; Stasz, Weinberg, & McDonald, 1974), student sex (e.g., Kehle, Bramble, & Mason, 1974; Stasz, Weinberg, & McDonald, 1974), and the match of teacher and student sex (e.g., Costin, Greenough & Menges, 1971; Goebes & Shore, 1975).

Method

Subjects

Teachers and students in eleventh, twelfth, and thirteenth grade English classes at an Ontario town secondary school participated in this study. The

school has an enrolment of over 1,000 pupils and offers a broad range of academic and vocational courses.

The four male and two female teachers in the study comprised the entire staff teaching English at these grade levels. Two classes of each teacher were selected. Two teachers each taught two eleventh grade classes, two teachers each taught one eleventh grade and one twelfth grade class, one teacher taught two twelfth grade classes, and one teacher taught two thirteenth grade classes.

English was chosen because it can be adequately and comfortably taught using either a directive or nondirective approach, and since the content is more value-laden than a subject such as mathematics, personal values, beliefs, and attitudes would be more apt to be expressed in the course of teaching.

Instruments

Teacher directiveness was measured with the Student Perception of Teacher Style (SPOTS) scale (Tuckman, 1968). Several teacher behaviors are rated by the teacher's students and the mean student score is taken as an index of the teacher's degree of directiveness, lower scores indicating a more directive style. Authoritarianism was measured with a modified version of the F-scale of Adorno et al. (1950) developed by Ezekiel and Athanasiou (Athanasiou, 1968; Ezekiel, 1970) which corrects for response bias, has a test-retest reliability of .86, and avoids the harsh quality of the items of the earlier F-scale (Weiss et al., 1970). Two items which deal with "Americanism" were replaced with two suitable items from another revised F-Scale (Kohn, 1972) because they do not have the same connotations in Canada. Dogmatism was measured with the 40-item Dogmatism Scale (Form E) developed by Rokeach (1960) to tap "general authoritarianism." Adequate reliability and validity for the scale has been demonstrated (e.g., Kerlinger & Rokeach, 1966; Rokeach, 1960; Vacchiano, Strauss, & Hochman, 1969).

As in the Weiss et al. study, two items were employed to measure satisfaction on 6-point Likert scales: (1) I am very satisfied with my present English teacher, and (2) My feelings toward my present English teacher are very favourable.

Procedure

Teachers were asked to complete the F-scale and the Dogmatism Scale after their cooperation had been secured by the head of the English department.

For each class, one period was used solely for the collection of student data. Only the researcher and the students were present. The number of students registered in each class at the beginning of the year had been determined from enrolment records. It was the authors' intention to collect data on about 80% of the students registered in the classes participating in the study. The questionnaires containing the SPOTS scale, the F-Scale, the Dogmatism Scale, and the two satisfaction items were unsystematically distributed and when the quota was reached students without a booklet were excused from the class.

For each student, the following information was determined from school files: student sex, teacher sex, IQ, academic program (four or five year), academic year, English grade on the January report, and the student's English teacher. The anonymity and confidentiality of student and teacher responses and file information was guaranteed through a coding plan.

Results

Of the 196 student questionnaires collected, 22 were discarded because they lacked certian information; compared to the total enrolment, the percentage of usable questionnaires for each of the six teachers' classes ranged from 59% to 83% with the mean being 68%.

Intelligence was measured by the Henmon-Nelson Test of Mental Abilities for 170 students, and the IQ of the four remaining students was measured by the Otis-Beta, the Dominion, the SRA, and the Lorge-Thorndike tests.

Approximately 44.8% of the students were male, the sex of the teacher and the student were matched in 42.5% of the cases, 57.5% of the students were in the eleventh grade, 26.4% were in the twelfth grade, and 16.1% were in the thirteenth grade. Approximately 62.1% of the students were in the five-year program. Descriptive statistics for the major variables are presented in Table 1.

TABLE 1
DESCRIPTIVE STATISTICS FOR THE SAMPLE

Variable	*M*	*SD*	Minimum	Maximum
Grades	64.8	11.7	27	95
Satisfaction	11.3	2.9	2	14
Teacher directiveness[a]	5.12	.49	4.53	5.71
Teacher authoritarianism[a]	82.5	13.1	59	97
Teacher dogmatism[a]	109.3	52.4	108	149
Student authoritarianism	102.6	15.7	68	150
Student dogmatism	163.1	25.9	86	227
Student intelligence	112.1	11.1	86	144

[a] Computed with an *N* of 6 rather than 174.

A second grades variable, "*z*-grades," was developed by computing the *z*-score of each student's grade, using each teacher's students as a subsample. It was thought that *z*-grades might be a better comparative index of standing across teachers. Satisfaction was uncorrelated with *z*-grades or grades. As expected, *z*-grades and grades correlated highly (r = .93).

Stepwise multiple regression strategies outlined by Cohen (1968) and Cohen and Cohen (1975) were used to analyze the hypothesized interaction effects. If the product of two independent variables is entered into a regression equation directly after the two independent variables, the significance of the amount of additional variance accounted for in the dependent variable indicates whether or not there is a significant linear interaction between the two independent variables. Accordingly, four

interaction variables were created: teacher directiveness x student authoritarianism, teacher directiveness x student dogmatism, teacher authoritarianism x student authoritarianism, and teacher dogmatism x student dogmatism. Therefore, the initial independent variables were the four product variables, teacher directiveness, teacher authoritarianism, teacher dogmatism, student authoritarianism, student dogmatism, student intelligence, teacher sex, student sex, the match of teacher and student sex, academic program, and two variables carrying the academic year information. The dependent variables were grades, *z*-grades, and satisfaction. All of the variables were transformed to *z*-scores for the regression analysis.

The results of the regression equations reported in Table 2 were deduced in the following manner. Successive predictors were entered into the regression equation in a partially predetermined order. All of the independent variables except those from which the interactions being tested were derived, were considered as covariates and entered first. The independent variables from which the interactions being tested were derived were entered second, and the variables containing the interactions which were being tested were entered last. The amount of variance in the dependent variable accounted for by the total combination of predictors was invariably significant ($p < .001$). The significance of the interaction effects was found by testing the increment in the amount of variance accounted for by the inclusion of the interaction variable or group of interaction variables (Cohen, 1968, p. 435).

In Step 1, the combined interaction effects of teacher directiveness and student authoritarianism, teacher directiveness and student dogmatism, teacher authoritarianism and student authoritarianism, and teacher dogmatism and student dogmatism were found to be insignificant with grades, *z*-grades, or satisfaction as the dependent variable. Therefore, the interactions were not tested individually.

Each student's score on the SPOTS scale was then used to create a "perceived teacher directiveness" variable. It was thought that the failure to find significant interaction effects might have been due to the restricted range of teacher directiveness scores, and also that perceived teacher directiveness might be somewhat independent of actual teacher directiveness. The perceived teacher directiveness variable was correlated with the teacher directiveness variable, $r(172) = .51$, $p < .001$. Employing perceived teacher directiveness rather than teacher directiveness, the correlation with satisfaction rose from .06 to significance, $r(172) = .34$, $p < .001$. In comparison, the correlation with grades dropped from an insignificant -.15 to .02. The corresponding correlation with *z*-grades rose from -.01 to .10. Correlations between perceived teacher directiveness and satisfaction were then computed separately for each teacher. Although numbers ranged from only 18 to 35, three of the correlations were significant and all six were positive: $r(26) = .67$, $p < .01$; $r(26) = .54$, $p < .01$; $r(28) = .40$, $p < .05$; $r(33) = .24$, ns; $r(16) = .19$, ns; $r(33) = .01$, ns.

Two product variables were created to carry the interactions of perceived teacher directiveness and student authoritarianism and perceived teacher directiveness and student dogmatism, and were transformed to *z*-scores. The perceived teacher directiveness variable was also standardized. The

TABLE 2
SUMMARIES OF THE REGRESSION ANALYSES OF THE INTERACTION EFFECTS

Step	Interaction(s) Tested	Dependent Variables	R^2 of independent variables entered as covariates	R^2 of covariates plus the independent variables from which the interaction variables were derived	R^2 of total number of independent variables	Significance of interaction(s) tested
1	TDIR x SAUTH	Grades	.251	.300	.307	F(4, 157) = .39
	TDIR x SDOG	z-grades	.191	.223	.243	F(4, 158) = 1.37
	TAUTH x SAUTH	Satisfaction	.176	.229	.248	F(4, 157) = .9[illegible]
	TDOG x SDOG					
2	PTDIR x SAUTH	Grades	.279	.286	.328	F(2, 159) = 4.8[illegible]**
	PTDIR x SDOG	z-grades	.206	.215	.261	F(2, 159) = 4.95**
		Satisfaction	.188	.314	.360	F(2, 159) = 5.61**
3	PTDIR x SAUTH	Grades	.280	.286	.316	F(1, 160) = 6.94**
		z-grades	.208	.215	.247	F(1, 160) = 6.75*
		Satisfaction	.220	.314	.315	F(1, 160) = .16
	PTDIR x SDOG	Grades	.283	.286	.306	F(1, 160) = 4.50*
		z-grades	.210	.215	.239	F(1, 160) = 4.89*
		Satisfaction	.191	.314	.355	F(1, 160) = 10.07**
4	PTDIR x SAUTH	Grades	.280	.280	.280	Insufficient F-level[a]
		z-grades	.208	.239	.261	F(1, 159) = 4.88*
	PTDIR x SDOG	Grades	.283	.283	.283	Insufficient F-level
		z-grades	.211	.241	.261	F(1, 159) = 3.05
		Satisfaction	.285	.315	.360	F(1, 159) = 11.06**
5a	PTDIR x SAUTH	Grades	.296	.296	.296	Insufficient F-level
	PTDIR x SDOG	z-grades	.219	.229	.268	F(2, 158) = 4.23*
		Satisfaction	.192	.334	.375	F(2, 158) = 5.18**
5b	PTDIR x SAUTH	Grades	.297	.297	.297	Insufficient F-level
		z-grades	.220	.229	.256	F(1, 159) = 5.78*
	PTDIR x SDOG	Grades	.299	.299	.299	Insufficient F-level
		z-grades	.221	.229	.249	F(1, 159) = 4.09*
		Satisfaction	.194	.334	.369	F(1, 159) = 8.66**
5c	PTDIR x SAUTH	z-grades	.222	.249	.268	F(1, 159) = 4.28*
	PTDIR x SDOG	z-grades	.224	.256	.268	F(1, 158) = 2.61
		Satisfaction	.315	.336	.375	F(1, 158) = 9.85**
6	TDIR x SIQ	Grades	.146	.146	.146	Insufficient F-level
	TAUTH x SIQ	z-grades	.074	.223	.230	F(3, 158) = .46
	TDOG x SIQ	Satisfaction	.199	.229	.255	F(3, 158) = 1.80
7a	PTDIR x SIQ	Grades	.170	.286	.289	F(1, 160) = .68
		z-grades	.079	.215	.218	F(1, 160) = .61
		Satisfaction	.206	.314	.333	F(1, 160) = 4.47*
7b	PTDIR x SIQ	Satisfaction	.206	.334	.354	F(1, 159) = 4.87*
7c	PTDIR x SIQ	Satisfaction	.206	.369[b]	.380	F(1, 158) = .34
7d	PTDIR x SDOG	Satisfaction	.194	.354[c]	.380	F(1, 158) = 6.66**

Note: TDIR - Teacher directiveness
SAUTH- Student authoritarianism
SDOG - Student dogmatism
TAUTH - Teacher authoritarianism
TDOG - Teacher dogmatism
PTDIR - Perceived teacher directiveness
SIQ - Student intelligence

[a] F-level or tolerance level insufficient for further computation.

[b] The variance accounted for by the interaction of perceived teacher directiveness and student dogmatism is also included.

[c] The variance accounted for by the interaction of perceived teacher directiveness and student intelligence is also included.

* $p < .05$
** $p < .01$

significance of the combined relationship of these two interactions to grades, *z*-grades, and satisfaction was tested in Step 2. The original teacher directiveness variable was not entered into the regression equation. The combined effect was significant ($p < .01$) with each dependent variable.

In Step 3, each interaction effect was tested separately. The interaction of perceived teacher directiveness and student authoritarianism was significantly related to grades, $F(1, 160) = 6.94$, $p < .01$, and to *z*-grades. The interaction of perceived teacher directiveness and student dogmatism was significantly related to grades, $F(1, 160) = 4.50$, $p < .05$, to *z*-grades, and to satisfaction.

In Step 4, an attempt was made to determine which of the two interactions in Step 3 is the primary interaction in regard to each dependent variable, or if the two interactions have overlapping effects. Each of the significant interaction effects in Step 3 was tested with the other interaction variable entered as a covariate directly before the interaction variable being tested. The interaction of perceived teacher directiveness and student authoritarianism was significantly related to *z*-grades; the interaction of perceived teacher directiveness and student dogmatism was significantly related to satisfaction.

In Step 5, the significant interaction effects found in Step 2, 3, and 4 were tested while the effects of actual teacher directiveness (as determined by Tuckman's recommended usage of the SPOTS scale) were controlled by entering teacher directiveness as a covariate. Tested as a pair in Step 5a, the interactions were significantly related to *z*-grades and to satisfaction. Tested separately in Step 5b, the interaction of perceived teacher directiveness and student authoritarianism was significantly related to *z*-grades, and the interaction of perceived teacher directiveness and student dogmatism was significantly related to *z*-grades and satisfaction. In Step 5c, with the effects of the interaction of perceived teacher directiveness and student dogmatism controlled, the interaction of perceived teacher directiveness and student authoritarianism was significantly related to *z*-grades, $F(1, 159) = 4.28$, $p < .05$. With the effects of the interaction of perceived teacher directiveness and student authoritarianism controlled, the interaction of perceived teacher directiveness and student dogmatism was significantly related to satisfaction, $F(1, 158) = 9.85$, $p < .01$.

Since intelligence has been found to correlate with authoritarianism (e.g., Weiss et al., 1970) and dogmatism and academic aptitude have been found to correlate (e.g., Steininger, 1970), an attempt was made to determine whether or not the present significant interaction effects could be explained by the interaction of perceived teacher directiveness and student intelligence. Four product variables were created—teacher directiveness x student intelligence, teacher authoritarianism x student intelligence, teacher dogmatism x student intelligence, and perceived teacher directiveness x student intelligence—and transformed to *z*-scores.

It was first determined in Step 6 that the combined effect of the interactions of teacher directiveness and student intelligence, teacher authoritarianism and student intelligence, and teacher dogmatism and student intelligence was insignificant in relation to grades, *z*-grades, and satisfaction. In Step 7a, it was found that the interaction of perceived

teacher directiveness and student intelligence was significantly related to satisfaction, but not to grades or *z*-grades, and remained so when teacher directiveness was entered as a covariate in Step 7b. In Step 7c, the perceived teacher directiveness x student dogmatism variable was entered directly before the perceived teacher directiveness x student intelligence variable, and it was found that the interactive relationship of perceived teacher directiveness and student intelligence to satisfaction was rendered insignificant. However, in Step 7d, when the perceived teacher directiveness x student intelligence variable was entered directly before the perceived teacher directiveness x student dogmatism variable, the interactive relationship of perceived teacher directiveness and student dogmatism to satisfaction remained significant.

In summary, with grades as the dependent variable in Step 3, there was a significant interaction between both perceived teacher directiveness and student authoritarianism and perceived teacher directiveness and student dogmatism. Neither of these interaction effects was significant in Step 4 when each of the interaction variables was tested with the other interaction variable entered before it in the regression equation and consequently controlled. Therefore, the two significant interaction effects of Step 3 are presented in Figure 1[1] and Figure 2.

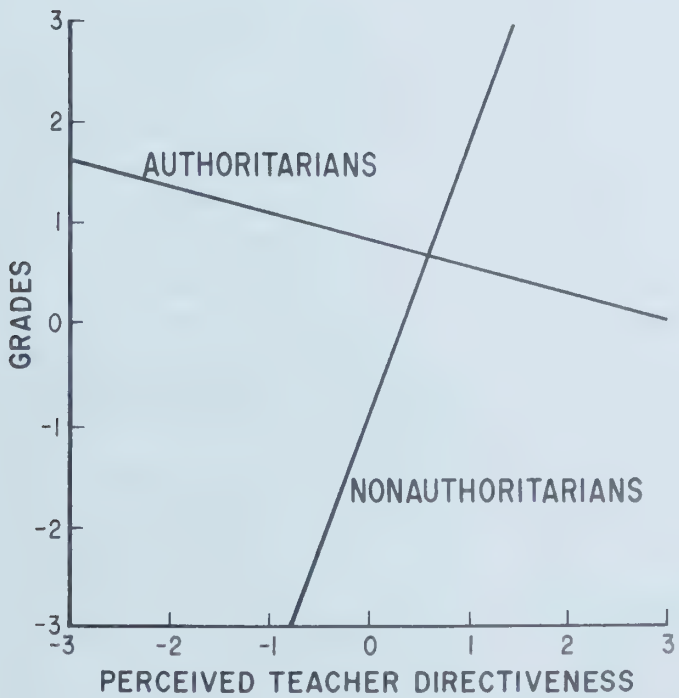

FIGURE 1

The interactive relationship of perceived teacher directiveness and student authoritarianism to grades in Step 3.

Note. The standardized form of the regression equation is: $z = .86x + 1.23y - 1.50\ xy$, where z = Grades, x = Student authoritarianism, and y = Perceived teacher directiveness.

The interactive relationship of perceived teacher directiveness and student authoritarianism to *z*-grades maintained even when teacher directiveness was controlled in Step 5c, and is presented in Figure 3. Similarly, the interactive relationship of perceived teacher directiveness and student dogmatism to satisfaction was also significant in Step 5c and is presented in Figure 4.

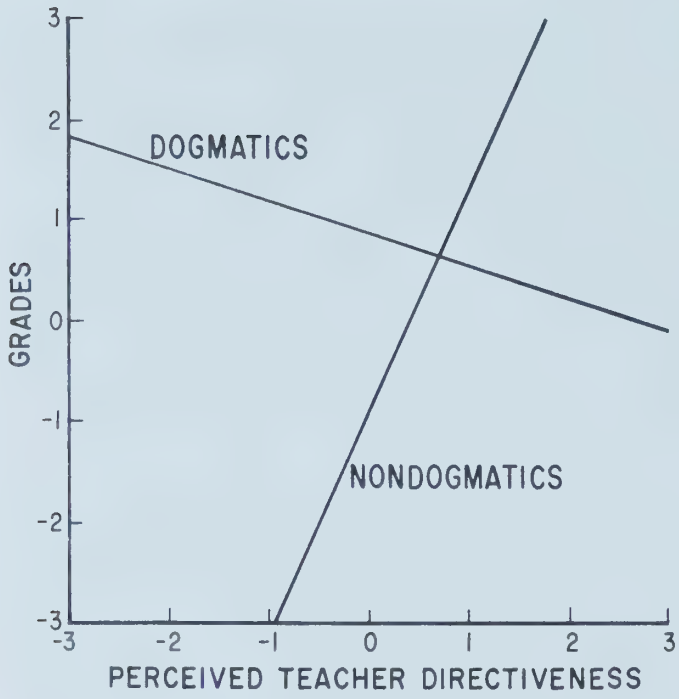

FIGURE 2

The interactive relationship of perceived teacher directiveness and student dogmatism to grades in Step 3.
Note. The standardized form of the regression equation is: $z = .86x + .95y - 1.27xy$, where z = Grades, x = Student dogmatism, and y = Perceived teacher directiveness.

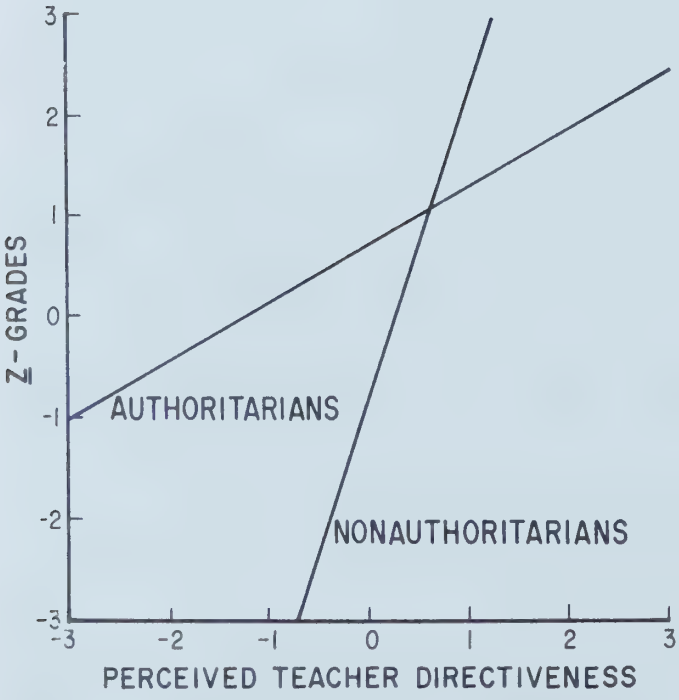

FIGURE 3

The interactive relationship of perceived teacher directiveness and student authoritarianism to *z*-grades in Step 5c.
Note. The standardized form of the regression equation is: $z = 1.83x + .73y - 1.26xy$, where z = *z*-grades, z = Perceived teacher directiveness, and y = Student authoritarianism.

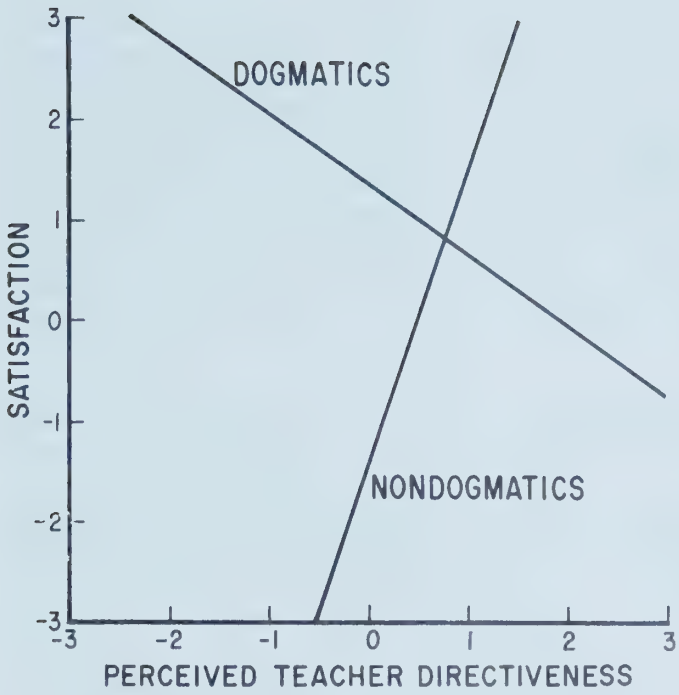

FIGURE 4
The interactive relationship of perceived teacher directiveness and student dogmatism to satisfaction in Step 5c.
Note. The standardized form of the regression equation is: $z = 1.33x + 1.14y - 1.84xy$, where z = Satisfaction, x = Student dogmatism, and y = Perceived teacher directiveness.

Discussion

The expected interactive relationships of teacher directiveness and student authoritarianism, teacher directiveness and student dogmatism, teacher authoritarianism and student authoritarianism, and teacher dogmatism and student dogmatism to grades, *z*-grades, and satisfaction were insignificant. However, several interactions involving teacher directiveness were significant when perceived teacher directiveness replaced the conventional measure of teacher directiveness.

Nonauthoritarian or nondogmatic students earned higher grades when they perceived the teacher to be nondirective; authoritarian or dogmatic students earned higher grades when they perceived the teacher to be directive. Both interactions accounted for much of the same variance in grades, since each was insignificant when the other was statistically controlled. Each interaction effect was also apparently contingent upon the actual level of teacher directiveness, since each was insignificant when teacher directiveness was statistically held constant.

Nonauthoritarian and authoritarian students both earned higher *z*-grades when they perceived the teacher to be nondirective, but the effect was more pronounced for nonauthoritarian students. This interaction effect remained significant when teacher directiveness was controlled.

The more valid dependent variable to represent student performance appears to be *z*-grades rather than grades. Grades can vary across teachers because of each teacher's accustomed mean, range, and distributional pattern. This variability, which may be unrelated to actual performance, is corrected with *z*-grades. The standardized version can be used as a comparative index of relative standing in the classes of each teacher and across the classes of all teachers.

Nondogmatic students were more satisfied when they perceived the teacher to be nondirective, while dogmatic students were more satisfied

when they perceived the teacher to be directive. This interactive relationship remained significant when teacher directiveness was controlled.

The preceding four interaction effects could not be accounted for by perceived teacher directiveness, teacher authoritarianism, teacher dogmatism, student authoritarianism, student dogmatism, student intelligence, teacher sex, student sex, the match of teacher and student sex, academic year, academic program, the interaction of perceived teacher directiveness and student intelligence, or the additive effects of these variables.

The step-wise regression procedure used here provides a conservative test of the effects of the interactions on grades, *z*-grades, and satisfaction. Only after the variance accounted for by the variables in the foregoing paragraph was removed from the dependent variable, were the interaction terms entered into the regression equation. These interaction terms had to account for significant amounts of additional criterion variance to reach statistical significance. It was not sufficient that they merely be related to the same variance accounted for by a prior term. Hence, the amount of unique variance accounted for by the interaction terms may seem somewhat small.

Teacher authoritarianism and dogmatism scores were low and had a narrow range. As Tuckman (1968) and Weiss et al. (1970) similarly argued, these factors may have attenuated interaction effects involving teacher authoritarianism and dogmatism. The restricted range of teacher directiveness scores may have also attenuated interaction effects involving teacher directiveness. However, it is the present authors' position that actual teacher directiveness is important in the present context only to the extent that it influences each student to perceive the teacher as being directive or nondirective. It might also be speculated that teacher authoritarianism and dogmatism are relevant in the present context to the extent that they influence perceived teacher authoritarianism and dogmatism.

There is evidence that perceived teacher directiveness is somewhat independent of actual teacher directiveness. There was a wide range of perceived teacher directiveness scores in the classes of each teacher, and for the most part, these scores were systematically related to satisfaction with each teacher. Students expressed greater satisfaction when they perceived the teacher to be nondirective. Since actual teacher directiveness (and not simply that estimated by the mean SPOTS scale score) was constant for each teacher, perceived teacher directiveness must be related to satisfaction in its own right. Further similar evidence is provided by the significant interactive relationships involving perceived teacher directiveness when the effects of teacher directiveness (as estimated by the mean SPOTS scale score) were statistically controlled.

The present study has helped to clarify the interactive relationship of teacher directiveness and student authoritarian tendencies to achievement and morale. Hitherto, significant interaction effects have not been reported. The expected nature of such interaction effects seems to have been generally correct, but one must consider that the teaching outcome is at least somewhat dependent on the students' perceptions of the classroom situation. Apparently, student authoritarianism interacts with perceived teacher directiveness in the determination of grades, while student dogmatism

interacts with perceived teacher directiveness in the determination of satisfaction.

The authors wish to thank Mr. G. Allan Snider, Director of Education; Mr. E. H. B. "Burt" Garrett, Principal; Mr. John S. Morgan, Vice-Principal; Mr. Haddon Meldrum and Mrs. Glenna Moore of the Guidance Department; and Mr. Peter J. Maule of the English Department at Parry Sound High School for their cooperation and assistance in the collection of the data.

Requests for reprints should be sent to Ronald J. Fisher, Department of Psychology, University of Saskatchewan, Saskatoon, Saskatchewan, S7N 0W0.

[1] In Figure 1, 2, 3, and 4, "authoritarians" and "dogmatics" are 1 *SD* above the *M*, while "nonauthoritarians" and "nondogmatics" are 1 *SD* below the *M*. The *M* of 0 was substituted for each of the variables in the original regression equation which are not present in each figure.

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The Alberta Journal of Educational Research *Vol. XXIII, No. 1, March, 1977*

M. HAUGHEY
E. A. HOLDAWAY
J. M. SMALL
The University of Alberta

Consultative Practices of Elementary School Teachers: Some Research Findings

This study sought detailed information about the consultative needs and practices of elementary school teachers. Questionnaires and interviews were used with 80 teachers in three elementary schools in one school system in Alberta. Assistance was most commonly desired in tasks related to special needs of students (e.g., diagnosis of learning difficulties), selecting instructional materials, operating audio-visual equipment, and developing course outlines. An extensive pattern of consultation among teachers was revealed, and teachers were generally satisfied with the assistance that they received. However, teachers with more years of post-secondary education or with more years of experience were less satisfied with this assistance.

Several recommendations are made. Principals should assess the consultative needs and capabilities of their staff more carefully, and school systems should probably emphasize specialist consultation services on the system level rather than the general consultation which can usually be adequately provided within schools. (Dr. Haughey is a sessional lecturer, Dr. Holdaway is a Professor, and Dr. Small is Associate Professor in the Department of Educational Administration, The University of Alberta.

Teachers, in common with people in most occupational groups, frequently seek opportunities to discuss aspects of their work with others, but the means by which such discussions occur vary widely. Three traditional models of teacher consultation may be referred to as "big brother," "fire fighter," and "casual visitor." In all cases, a superordinate-subordinate relationship is assumed, with the teacher, inevitably, assuming the latter role, while the superordinate is either the principal or someone designated by the system as consultant or supervisor.

The "big brother" approach is most often seen in relation to an inexperienced or new member on the school staff. The principal or other

supervisor is seldom far from the classroom and is ready to offer advice on a multitude of matters, whether it is solicited or not. By contrast, the "fire fighter" is called in, or rushes in, when emergency situations arise which the teacher is incapable of handling, such as disruptive pupils or untenable working situations. The "casual visitor" drops in from time to time as a means of informal quality control, to maintain communications, and occasionally to inform the teacher of prospects and programs which may be of interest.

These models of supervision all rest upon the inherent assumptions which may limit their potential usefulness to a teaching force which is becoming increasingly professionalized. The assumptions are that teachers as a body do not recognize their own needs and lack the motivation to initiate consultation, and as a corollary, that teachers are not viewed as having resources which may be valuable to their colleagues.

Many commentators have questioned the assumptions behind hierarchial supervision, and have looked towards a more open mode of communication among educators at all levels (for example: Lucio, 1967; Sergiovanni & Starratt, 1971; MacKay, 1971; and Miklos, 1971).

More and more, teachers are perceived to be the best judges of what they need to know, how and from whom this knowledge should be acquired, and from the information so obtained, what can best be integrated with their own teaching styles. The study reported here provides a further test of the validity of this perception by examining the dynamics of consultative encounters between in-school personnel at the elementary level in a small urban school system in Alberta.

Identification of Consultants

A number of studies have focused on the personnel with whom teachers discuss their concerns and those perceived as valuable sources of assistance. From a general review of studies in these areas, Holdaway (1971) noted that (1) only a small percentage of a school system's staff are designated as consultants, (2) these people are unable to meet all the demands for their services, (3) principals have not enough expertise to provide the kind of specialist help required by teachers, (4) principals are key figures in the provision of a supportive, facilitating and motivating climate, and (5) the major task of the consultant should be to help teachers solve problems which the teachers have identified.

Parsons (1971) asked 697 elementary teachers in West Central Ontario to identify and to rate the effectiveness of supervisory personnel who affected their classroom instruction. Principals were rated as being the most influential and most effective; they were followed in order by other teachers, resource teachers, and program consultants. However in three separate studies (McGillivray, 1966; Moller, 1968; and Milne, 1968), beginning teachers reported that they received most help from fellow teachers and department heads, and least help from principals and central office personnel. The importance of other teachers as sources of consultation is apparent from these studies, a conclusion which led Parsons (1971) to suggest that:

> . . . greater opportunities be provided for teacher interaction in school systems by

> restructuring teacher roles. Teachers should be given greater freedom from their "in-class" responsibilities to share new ideas and techniques with their colleagues. (p. 8)

Identification of Needs

Research in identification of the consultative needs of teachers has been almost completely confined to first-year teachers. Moller (1968) and Franc (1970) found that a variety of instructional problems were encountered by beginning teachers, and that these were related to concerns of personal competence. Problems occurred in student motivation, grading, meeting individual differences, discipline, working with low-ability students, finding a satisfactory speed for covering course materials, making satisfactory tests, lack of teaching creativity, and a tendency to "talk over students' heads."

Beyond the first years, Fuller and Parsons (1968) and Fuller (1969) suggested that different teacher concerns emerge after different periods of experience. Kass (1975) further developed this idea and postulated a three-stage concern sequence for practising teachers, with self-adequacy being predominant in Stage 1, content and methodology in Stage 2, and concerns with individual student needs in Stage 3.

In general the literature supports the ideal of continuous development throughout the teacher's career in a work environment characterized by the free flow of information between colleagues.

Method

Haughey (1976) sought to describe consultative practices in selected Alberta schools. In particular, teachers were asked to provide information concerning their consultative needs, the personnel whom they consulted, their perceptions of themselves as consultants, their satisfaction with the consultative assistance which they received, and any reasons for not seeking assistance.

Population

The population for the study consisted of all 80 teachers in three elementary schools in one school system in Alberta. This particular system was chosen because some preliminary research had already been conducted in the system, because interviews could be conducted in the time available with all 80 teachers, and because the superintendent and staff were interested and cooperative. This population was not considered to be a sample for inferential purposes of either all elementary teachers in past or future years in the system, or elementary teachers in other school systems. An in-depth approach was chosen in order to obtain detailed information about all teachers in one system: this could lead to hypotheses which may be tested later using comprehensive sampling procedures.

Instrument

Data were collected by means of (1) a questionnaire and (2) an interview schedule designed to clarify and elaborate upon written responses in the questionnaire. Twenty-one task areas were arbitrarily grouped into four categories called "curriculum and program," "instructional," "audio-visual technology," and "special student needs."

The *questionnaire* was based on one used by Plamondon (1973) in earlier research on consultation in the same school system. For each task area, teachers were asked to check if they had desired consultative assistance and whether this had occurred more than once during the school year. Some demographic data were also requested. To ensure that the questions were valid, clear and unambiguous, the questionnaire was distributed to five practicing teachers, three university professors, five graduate students, and to the superintendent, assistant superintendent and three principals in the participating system. Their reactions led to certain changes being made in content and wording: the amended questionnaire was then completed by four elementary teachers in a non-participating elementary-junior high school in the same system.

During the *interviews*, teachers were asked to state their particular concerns, their times of occurrence, the people consulted, and ratings of assistance received from each consultant. They were also asked to identify the staff members for whom they had provided assistance, the task areas in which they had provided assistance, and the frequency of their provision of assistance. The interview schedule was tested and amended using the same procedure as outlined above for the questionnaire.

Data analysis

The raw data consisted of frequency counts, most of which were converted into percentage frequency distributions. Because a population of teachers was used rather than a sample, inferential statistics were not appropriate. Rather, comparisons were made between the size of selected percentage frequencies, with arbitrary decisions being made about the substantial significance of differences in percentages. This method did not allow for projections to be made beyond the population being studied.

Results

Areas in Which Teachers Desired Consultative Assistance

Over 50 percent of the teachers had expressed a desire for consultative assistance in each of seven task areas (Table 1). Fifty-five percent desired assistance in "developing course outlines," 73 percent in "selecting instructional materials," and 64 percent in "operating audio-visual equipment." In all four task areas listed in the special student needs section, over 50 percent of teachers desired assistance. Eighty-five percent of teachers mentioned "diagnosis of learning difficulties," which was the highest percentage of teachers desiring assistance in any task area: the other special student needs task area percentages were "developing remedial programs" (75 percent), "obtaining student-background information" (54 percent), and "solving teacher-pupil problems" (51 percent).

In all, 689 concerns were mentioned by teachers; the highest percentage of these (10 percent) was in the area of "diagnosis of learning difficulties." Nine percent of concerns were in "developing remedial programs," eight percent in "selecting instructional materials," seven percent in "operating audio-visual equipment," and six percent in each of "developing course outlines," "obtaining student-background information," and "solving teacher-pupil problems."

TABLE 1
PERCENTAGE OF TEACHERS DESIRING CONSULTATIVE ASSISTANCE IN EACH TASK AREA AND PERCENTAGE DISTRIBUTION OF CONCERNS IN EACH TASK AREA FOR ALL TEACHERS

TASK AREA Description	Teachers (*N*=80) %	Concerns (*N*=689) %
CURRICULUM AND PROGRAM		
Developing course outlines	55.0[a]	6.4[b]
Selecting instructional materials	72.5	8.4
Developing unit/lesson plans	47.5	5.5
Developing instructional materials	47.5	5.5
Evaluating lessons/units	27.5	3.2
Interpreting curriculum guides	16.3	1.9
INSTRUCTIONAL		
Developing questioning techniques	13.8	1.6
Teaching concepts, constructs, generalizations	35.0	4.1
Planning role-playing	15.0	1.7
Developing/using small group activities	35.0	4.1
Planning individualized instruction	46.3	5.4
Using problem-solving/inquiry/discovery method	13.8	1.6
Leading discussions	11.3	1.3
Grouping for instruction	35.0	4.1
AUDIO-VISUAL TECHNOLOGY		
Operating audio-visual equipment	63.8	7.4
Using kits, charts, games, simulations	35.0	4.1
Developing own audio-visual materials	22.5	2.6
SPECIAL STUDENT NEEDS		
Diagnosis of learning difficulties	85.0	9.9
Developing remedial programs	75.0	8.9
Obtaining student-background information	53.8	6.3
Solving teacher-pupil problems	51.3	6.0

[a] 55% of the 80 teachers in the study desired consultative assistance in Task Area "Developing course outlines."

[b] Of the 689 concerns mentioned by the 80 teachers in the study, 6.4% were in Task Area "Developing course outlines."

Education and experience. The responses indicating teacher concerns in each task area were examined on the basis of years of post-secondary education (Table 2). Greater percentages of teachers with three or more years of post-secondary education desired assistance on more task areas than did teachers with one or two years of post-secondary education. In contrast, as shown in Table 3, lower percentages of teachers with over ten years of teaching experience desired consultative assistance than did teachers with ten or fewer years of teaching experience.

Recurring concerns. Teachers were asked to specify for each concern the time of year it occurred. Where the concern emerged more than once it was labelled a recurring concern. The majority of concerns in all areas except "interpreting curriculum guides" were recurring concerns.

Frequency of consultation. The number of times each teacher was consulted in each task area and in each section was also examined (Table 4).

TABLE 2
PERCENTAGE OF TEACHERS DESIRING CONSULTATIVE ASSISTANCE IN EACH TASK AREA, BY YEARS OF POST-SECONDARY EDUCATION

TASK AREA Description	Years of Post-Secondary Education 1-2 %	3 %	4 %	5-6 %
CURRICULUM AND PROGRAM				
Developing course outlines	30.0	58.8	59.0	57.1
Selecting instructional materials	70.0	82.4	62.2	71.4
Developing unit/lesson plans	40.0	58.8	53.9	21.4
Developing instructional materials	10.0	76.5	48.7	35.7
Evaluating lessons/units	10.0	41.2	25.6	28.6
Interpreting curriculum guides	10.0	11.8	20.5	14.3
INSTRUCTIONAL				
Developing questioning techniques	10.0	5.9	15.4	21.4
Teaching concepts, constructs, generalizations	30.0	47.1	33.3	28.6
Planning role-playing	10.0	29.4	12.8	7.1
Developing/using small group activities	20.0	52.9	38.5	14.3
Planning individualized instruction	20.0	76.5	46.2	28.6
Using problem-solving/inquiry/discovery method	0.0	23.5	12.8	14.3
Leading discussions	0.0	17.7	12.8	7.1
Grouping for instruction	20.0	35.3	38.5	35.7
AUDIO-VISUAL TECHNOLOGY				
Operating audio-visual equipment	70.0	70.6	59.0	64.3
Using kits, charts, games, simulations	10.0	47.1	38.5	28.6
Developing own audio-visual materials	10.0	35.3	15.4	35.7
SPECIAL STUDENT NEEDS				
Diagnosis of learning difficulties	90.0	88.2	84.6	78.6
Developing remedial programs	70.0	94.1	76.9	50.0
Obtaining student-background information	40.0	76.5	46.2	57.1
Solving teacher-pupil problems	50.0	52.9	56.4	35.7
N	10	17	39	14
	100.0	100.0	100.0	100.0

In one school the principal, assistant principal, guidance counsellor, two teachers who were involved in remedial work, a Grade 5 teacher and a Grade 6 teacher were each consulted on at least 30 occasions between September and February. In the second school, the personnel consulted most often were the principal, the guidance counsellor, the Grade 1 teacher aide (a fully qualified teacher), two Grade 1 teachers and the remedial-reading teacher. In the third school the assistant principal was consulted on 64 occasions, while other personnel consulted at least 23 times were the principal, the remedial-reading teacher and a Grade 3 teacher who provided most assistance with audio-visual problems.

Rating of Consultative Assistance

Teachers generally were satisfied with the information which they received from the teachers who provided assistance for them. Of the 80 teachers, only five had concerns for which they were unable to find a satisfactory answer. One teacher was new to the staff and to the system in

TABLE 3
PERCENTAGE OF TEACHERS DESIRING CONSULTATIVE ASSISTANCE IN EACH TASK AREA, BY TOTAL YEARS OF TEACHING EXPERIENCE

Description	Total Years of Teaching Experience				
	1-3	4-6	7-10	11-20	Over 20
	%	%	%	%	%
CURRICULUM AND PROGRAM					
Developing course outlines	68.0	72.2	54.6	31.6	28.6
Selecting instructional materials	80.0	77.8	90.9	52.6	57.1
Developing unit/lesson plans	72.0	44.4	63.6	21.1	14.3
Developing instructional materials	72.0	44.4	45.5	31.6	14.3
Evaluating lessons/units	36.0	33.3	27.3	15.8	14.3
Interpreting curriculum guides	28.0	11.1	27.3	5.3	0.0
INSTRUCTIONAL					
Developing questioning techniques	20.0	22.2	18.2	0.0	0.0
Teaching concepts, constructs, generalizations	44.0	44.4	18.2	36.8	0.0
Planning role-playing	20.0	22.2	18.2	5.3	0.0
Developing/using small group activities	44.0	33.3	54.6	26.3	0.0
Planning individualized instruction	44.0	50.0	72.7	47.4	0.0
Using problem-solving/inquiry/discovery method	8.0	27.8	9.1	10.5	14.3
Leading discussions	28.0	5.6	9.1	0.0	0.0
Grouping for instruction	40.0	44.4	45.5	26.3	0.0
AUDIO-VISUAL TECHNOLOGY					
Operating audio-visual equipment	84.0	66.7	63.6	42.1	42.9
Using kits, charts, games, simulations	56.0	38.9	36.4	15.8	0.0
Developing own audio-visual materials	36.0	22.2	27.3	0.0	28.6
SPECIAL STUDENT NEEDS					
Diagnosis of learning difficulties	84.0	77.8	100.0	89.5	71.4
Developing remedial programs	84.0	61.1	90.9	84.2	28.6
Obtaining student-background information	64.0	55.6	72.7	36.8	28.6
Solving teacher-pupil problems	52.0	44.4	81.8	42.1	42.9
N	25	18	11	19	7
	100.0	100.0	100.0	100.0	100.0

January, one teacher was unhappy at the level of interaction with her fellow grade teacher, and three were specialists with no other teachers teaching that subject in the school.

In only 123 of the 1545 consultations were the consultants unable to provide information that was satisfactory for the clients. The distribution of teachers' ratings of consultative assistance in each task area is given in Table 5.

In general, teachers rated the consultative assistance which they obtained as "satisfactory" or "very satisfactory." The area in which they were least satisfied was "interpreting curriculum guides" where one-third of the ratings were "not very satisfactory." Teachers also had difficulty finding satisfactory information about "using problem solving/inquiry/discovery method," with 25 percent of ratings being "not very satisfactory."

Teachers' satisfaction tended to decrease with increasing years of post-secondary education. Teachers with one or two years of post-secondary

TABLE 4
NUMBER OF TIMES EACH TEACHER WAS NAMED AS CONSULTANT

	Teacher No.	No. of Times	Teacher No.	No. of Times	Teacher No.	No. of Times
School 1						
	4	35	16	15	28	35
	5	4	17	13	29	10
	6	19	18	5	30	17
	7	12	19	27	31	11
	8	49	20	14	32	58
	9	6	21	12	33	64
	10	3	22	5	34	7
	11	8	23	17	35	11
	12	12	24	26	36	2
	13	17	25	32	37	12
	14	30	26	20	38	10
	15	13	27	30		
School 2						
	4	57	12	8	20	0
	5	23	13	8	21	5
	6	8	14	10	22	1
	7	23	15	14	23	24
	8	13	16	9	24	4
	9	7	17	0	25	2
	10	6	18	5	26	15
	11	5	19	25	27	25
School 3						
	4	17	12	12	20	23
	5	2	13	10	21	9
	6	15	14	17	22	17
	7	11	15	7	23	29
	8	14	16	11	24	10
	9	64	17	1	25	12
	10	17	18	42		
	11	4	19	6		

Note. Mean number of times teachers were named as consultants: School 1 = 16.5
School 2 = 12.6
School 3 = 15.9

education rated 58 percent of their consultations as "very satisfactory"; teachers with five or six years of post-secondary education indicated that only 33 percent of their consultations were "very satisfactory." When responses were classified according to years of teacher experience, the pattern was similar, with the percentage of consultations in the "not very satisfactory" category rising from 8 percent for teachers with one to three years of experience to 26 percent for teachers who had over 20 years of teaching experience.

Dissatisfaction with peer consultation appeared, then, to be related to years of post-secondary education and years of experience. A similar kind of relationship existed in regard to the expressed need for consultative help. Ideally teachers expressing a high need for consultation would also indicate a high level of satisfaction, but as Figure 1 shows, this was true only for teachers iwth less experience when their level of formal education is disregarded. Teachers with more post-secondary education, while ex-

TABLE 5
DISTRIBUTION OF TEACHERS' RATINGS OF CONSULTATIVE ASSISTANCE IN EACH TASK AREA

TASK AREA Description	Rating of Assistance: Very satisfactory %	Satisfactory %	Not very satisfactory %	No. of ratings
CURRICULUM AND PROGRAM				
Developing course outlines	40.3[a]	52.2	7.5	134
Selecting instructional materials	56.2	40.9	2.9	137
Developing unit/lesson plans	34.4	62.2	3.3	90
Developing instructional materials	44.9	49.4	5.6	89
Evaluating lessons/units	30.0	66.7	3.3	30
Interpreting curriculum guides	11.1	55.6	33.3	27
INSTRUCTIONAL				
Developing questioning techniques	22.2	66.7	11.1	9
Teaching concepts, constructs, generalizations	23.0	65.6	11.5	61
Planning role-playing	18.2	81.8	0.0	11
Developing/using small group activities	42.1	45.6	12.3	57
Planning individualized instruction	40.3	44.2	15.6	77
Using problem-solving/inquiry/discovery method	60.0	15.0	25.0	20
Leading discussions	100.0	0.0	0.0	4
Grouping for instruction	36.8	52.6	10.5	76
AUDIO-VISUAL TECHNOLOGY				
Operating audio-visual equipment	69.3	30.7	0.0	75
Using kits, charts, games, simulations	58.1	41.9	0.0	62
Developing own audio-visual materials	44.8	51.7	3.5	29
SPECIAL STUDENT NEEDS				
Diagnosis of learning difficulties	43.9	44.4	11.7	214
Developing remedial programs	44.2	45.7	10.1	129
Obtaining student-background information	50.9	46.4	2.7	112
Solving teacher-pupil problems	40.2	51.0	8.8	102

[a] 40.3% of the ratings in "Developing course outlines" were in the "Very Satisfactory" category.

FIGURE 1
POSSIBLE RELATIONSHIPS BETWEEN NEED FOR AND SATISFACTION WITH CONSULTATIVE PROCEDURES FOR TEACHERS CLASSIFIED BY (1) MORE OR LESS EXPERIENCE AND (2) MORE OR LESS POST-SECONDARY EDUCATION.

NEED	SATISFACTION: High	SATISFACTION: Low
High	less experience	more post-secondary education
Low	less post-secondary education	more experience

pressing a high need for consultation, regarded peer consultation as less satisfactory than did less qualified teachers.

In all, 27 teachers had concerns for which they did not seek assistance. They mentioned thirteen reasons for not doing so. These reasons fell into three main categories: (1) those where the concern was not crucial but was one where the teacher would like more information; (2) those where the teacher either had no time, no materials, no one to ask or did not know whom to ask; and (3) those where the information became available without seeking assistance. Reasons listing the concern as not crucial were given 24 times, a lack of knowledge of sources 70 times, and where the information became available 13 times.

Discussion

Implications for Administrators

Several issues having implications for school administrators appear to arise from these findings, even though they are based upon a small population of elementary teachers from one system. Teachers in this study viewed each other as productive sources of consultation and interacted regularly on professional matters which tended to focus on practical concerns and instructional procedures. With the exception of interpretation of curriculum guides these concerns arose from time to time throughout the school year. Teachers apparently are prepared to consult a number of their colleagues, presumably those whom they can conveniently contact and in whom they have some confidence. Apparently they regard specially designated teachers such as the principal, vice-principal and librarian in much the same light as they do other teachers. The level of satisfaction with consultative advice acquired in this way is generally high, although some dissatisfaction was reported. To what extent should this resource be further developed and formalized in order to take full advantage of it? Not all teachers consult in depth with their colleagues. Would more do so if more formal procedures were established and recognition given to this form of service? Or would an attempt to formalize a spontaneous consultative network lead to less use of peer consultation? Until more is known about teacher-teacher consultative patterns, each principal should develop a consultation structure appropriate to his school.

Consultative resources within school staffs probably will alter from year to year because of the ad hoc nature of the composition of staffs of most schools, annual staff changes, and in particular in-service programs they have experienced. Teachers' needs and potentialities within each school will also vary. The principal therefore continuously needs to assess his staff and each year, with their consent, develop an inventory of interests and talents which can be utilized. At the same time he can anticipate that certain regular needs will surface, such as curriculum advice, near the beginning of the school year, and advice on special pupil problems during the year. By taken action to meet these concerns through such an inventory, the most common obstacles for not obtaining help, namely lack of resources or lack of information on whom to consult, could be reduced.

A plausible explanation for the finding that the more experienced teachers were less satisfied with peer consultation than were their less

experienced colleagues is that the latter group lack the specific practical information which is needed to function in the classroom, but which is not provided for in preparation programs. Further, formal training raises the level of awareness of information needs and also sharpens the critical appraisal of any help which is forthcoming. A hypothetical relationship of this type merits further investigation perhaps leading to a theory of differential supervision in which, for instance, better-qualified experienced teachers are encouraged to act as resource teachers to less-qualified inexperienced teachers. At the same time the former group could be given easier access to specialized consultants at the system level, thus making more efficient use of human resources.

Other possible inferences are suggested. Those teachers with less education and more experience who are expressing less need for consultation, and who are therefore less likely to seek help, might profitably be given more opportunities to compare their teaching with that of others. However, strategies such as this based on restricted research data can be advocated only with caution.

Implications also arise for the system administrator. System consultants who have generalist training may feel most comfortable in general supervision, such as visits to new teachers. But, if teachers can get this kind of help directly from their in-school colleagues, then system-level consultation should probably emphasize more specialist services such as diagnosing learning difficulties. A move in this direction could have the double benefit of making school staffs more professionally responsible through increased collegiality and at the same time provide an incentive for further professional specialization of consultants.

Implications for Further Research

Haughey's study was limited to three elementary schools in one school system which had very restricted central office consultative assistance available to teachers. Replication of this study in the following situations is highly recommended:

(1) in secondary schools in systems which have few central office consultative staff;

(2) in schools in systems which have substantial numbers of central office consultative staff;

(3) in schools in sparsely populated systems which require considerable travel of central office staff; and

(4) in schools in systems which utilize consultants based in "families of schools."

Data from such additional studies would again be largely descriptive and perceptual. Introduction of evaluative elements in researching this topic, although desirable, would be difficult. Participant-observer studies of the nature and effectiveness of different types of consultation in different settings (school level, number of consultants, location of consultants, etc.) may be possible. More attention needs to be given to statistical relationships among measures of expressed need and satisfaction and such variables as training and years of experience.

Now that many school districts across Canada are facing declining populations, and consequently have declining funds available for payment of personnel who do not instruct in a classroom, information about how teachers receive help with their difficulties would appear to be even more important than ever.

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